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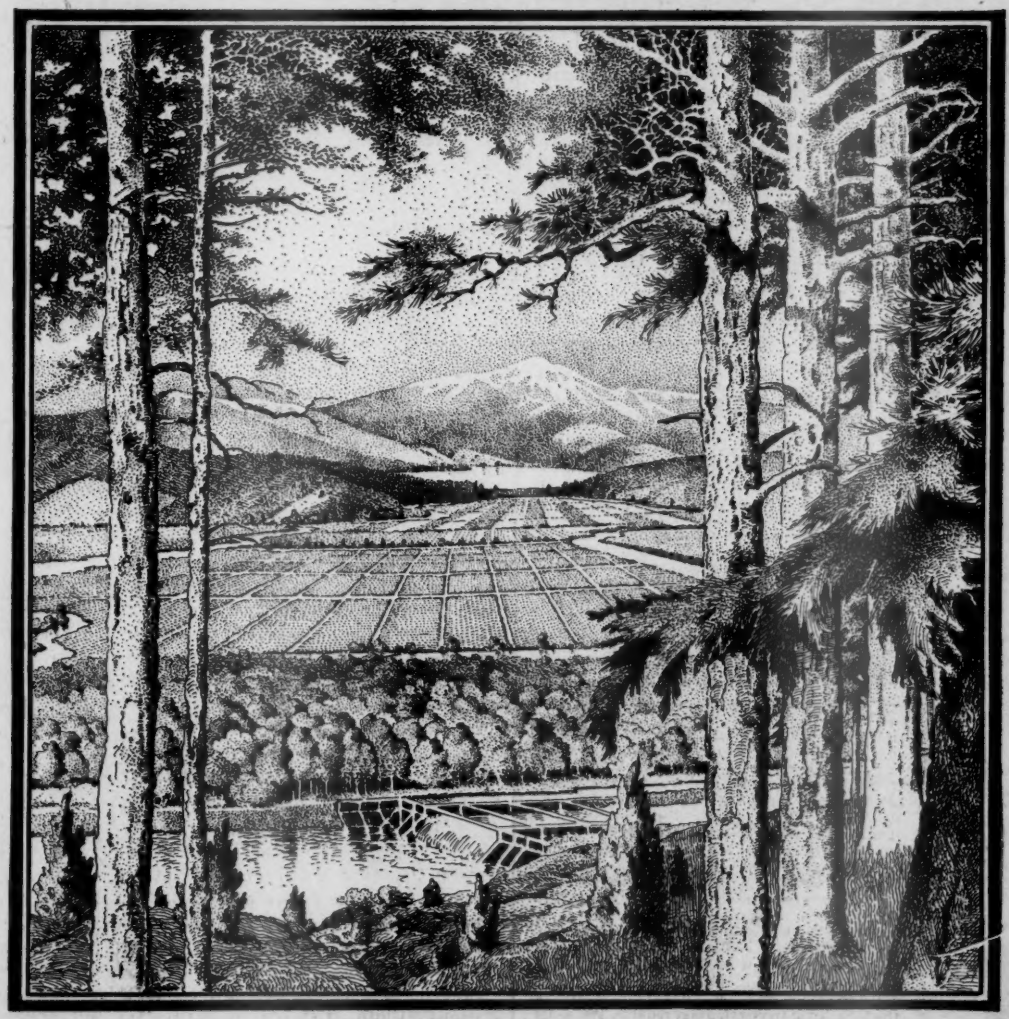

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The American Forestry Association was organized in 1882, and incorporated in January, 1897. It now has nearly three thousand members, residents of every State in the Union, Canada, and foreign countries. It has at all times been active in promoting measures tending toward the proper utilization of the forests and their protection from destruction by fires and wasteful use.

The objects of this Association are to promote:

1. A business-like and conservative use and treatment of the forest resources of this country;
2. The advancement of legislation tending to this end, both in the States and the Congress of the United States, the inauguration of forest administration by the Federal Government and by the States; and the extension of sound forestry by all proper methods;
3. The diffusion of knowledge regarding the conservation, management, and renewal of forests, the proper utilization of their products, methods of reforestation of waste lands, and the planting of trees.

The Association desires and needs as members all who are interested in promoting the objects for which it is organized—all who realize the importance of using the natural resources of the country in such a manner as not to exhaust them, or to work ruin to other interests. In particular it appeals to owners of wood-lands, to lumbermen and foresters, as well as to engineers, professional, and business men who have to do with wood and its manifold uses, and to persons concerned in the conservation of water supplies for irrigation or other purposes.

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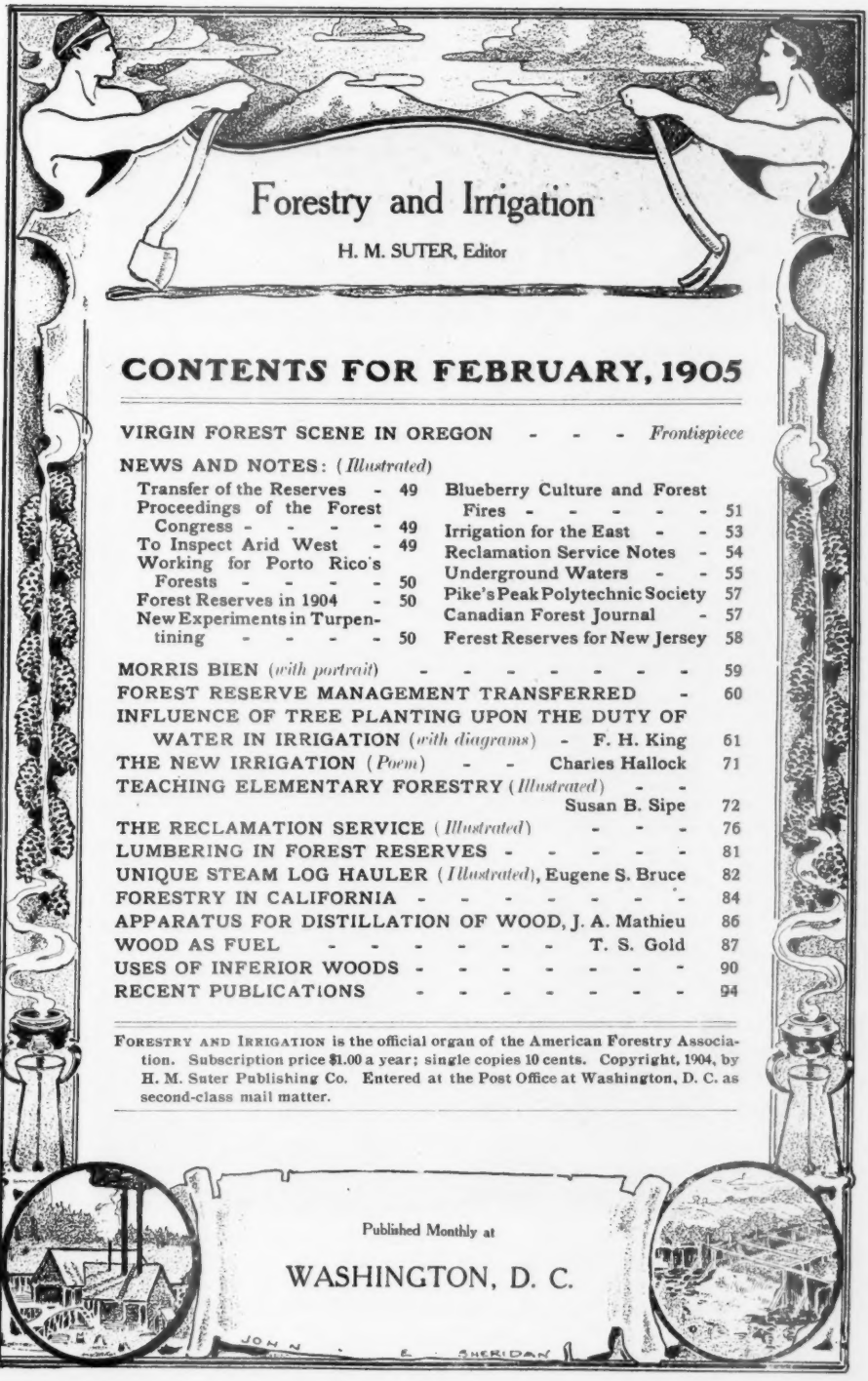

Forestry and Irrigation

H. M. SUTER, Editor

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WASHINGTON, D. C.

Virgin Forest Scene in Oregon.

NEWS AND NOTES

Transfer of the Reserves.

At last the transfer of the forest reserves from the Department of the Interior to the Department of Agriculture is an accomplished fact. The bill for this purpose passed Congress the last week in January, and was signed by President Roosevelt on February 1st. From now on the administration of the reserves, as outlined in an article elsewhere in this number of FORESTRY AND IRRIGATION, will be directly under the control of the Bureau of Forestry.

This transfer of the administration of the forest reserves has come after many vexatious delays. For four years the friends of forestry have stood together to bring about this result. The American Forestry Association was a potent factor in the creation of the reserves, and the first laws for their administration, and it has likewise been a powerful ally in the move for the consolidation of all forest work. With the active management of the reserves in the hands of Mr. Gifford Pinchot, who has fought so tenaciously during the past four years to bring about the transfer, we may look for a sensible, business-like handling of the public forest lands. This victory in securing the transfer of the forest reserves in the face of much selfish opposition is one of great consequence, and reflects the greatest credit on the movement headed by Mr. Pinchot. It should encourage all friends of conservative forest management to keep hard at work for the numerous projects of like nature which should be carried through at an early date.

Proceedings of the Forest Congress.

The complete proceedings of the American Forest Congress, held at Washington January 2d to 6th, will be published in book form, March 15th. The volume will contain in the neighborhood of 400 pages, and will be neatly bound in cloth. It will contain the full text of all addresses and papers delivered at the Congress, the resolutions passed, and list of the delegates who attended. Altogether it will make the most comprehensive and authoritative volume on forestry that has yet been issued in the United States. The publication of the proceedings will be handled for the Association by the H. M. Suter Publishing Company, of Washington, who are the publishers of this magazine. The price of the volume will be $1.25, postpaid. Persons desiring copies of the proceedings should send in their orders at once, accompanied by check or money order for the amount.

To Inspect Arid West.

The Senate and House Committees on Irrigation have arranged for a trip through the entire arid West next June and July, starting at Omaha and going first to Nevada, where, on June 17th, the third anniversary of the approval of the reclamation act, they will witness the formal completion of the Truckee irrigation project. This will be the first project to be completed under the reclamation act.

The members of the committee will then go to New Mexico and Arizona, taking in various projects in both territories. They will make a personal inspection from Yuma of the Colorado river valley, including the Imperial country, in order to become familiar with what has proved to be a perplexing problem in irrigation development.

The committees will then make a tour of Southern California, inspecting irrigation plants and will be entertained at Los Angeles, going thence to San Francisco. Meetings will be held for the purpose of gathering information regarding the big Sacramento valley project, which is declared by officials of the reclamation service to be the largest project in the United States. Visits will be made to various places in the Sacramento valley, and thence to Oregon, Washing-

ton, Montana, Idaho, Wyoming and Colorado. The Senators on the Irrigation Committee who are expected to make this trip are: Warren, Hansbrough, Ankeny, Fulton, Bailey, Patterson, Gorman, and Newlands. The members of the House Committee are: Mondell, Reeder, Tyrrell, Dwight, Marshall, Cooper, Williamson, Underwood, Hitchcock, and Van Duser.

Working for Porto Rico's Forests. Efforts are being made by the citizens of Porto Rico to secure legislation looking to the preservation of the forests of that territory. The establishment of the Luquillo Forest Reserve in Porto Rico has brought to public attention the vast benefits that come from proper forest conservation and protection, and has impelled some of Porto Rico's most prominent citizens to lend their aid to the forest movement, and endeavor to secure legislation during the present session of the Porto Rico Legislature. Porto Rico possesses the only distinctly tropical forest that is a part of the United States in this hemisphere, and legislation looking to an administration of its forest wealth on the principles of practical forestry should have the support of all public-minded citizens.

Forest Reserves in 1904. In 1904 seven new forest reserves were created—Baker City, in Oregon; Cave Hills and Slim Buttes, in South Dakota; Grantsville and Salt Lake, in Utah, and Warner Mountains and Modoc, in California. Additions were made to the Fish Lake (Utah), the South Platte (Colorado), and the Big Horn (Wyoming) reserves. These reserves cover in the aggregate 893,136 acres. A total area of 310,241 acres were added to existing reserves, but 923,782 acres, which examination had shown to be better suited for agriculture than for foresty were restored to the public domain, so that the net increase in the area of the reserves was but 149,035 acres.

New Experiments in Turpentining. The old system of boxing Southern pine trees for the production of turpentine and rosin has very greatly reduced the pine timber wealth of the Southern States. Three years ago the Bureau of Forestry determined that something should be done to eliminate so destructive a method of procuring naval stores. Its three years' experiments towards this end, just completed, have demonstrated that a new system of turpentining, which requires the use of earthen cups and metal gutters, not only greatly conserves the life of the timber tapped, but gives an increased yield of rosin, and therefore a greater profit than is possible by boxing. The box method and the new cup and gutter system of turpentining are fully described and illustrated in Bulletin No. 40, issued by the Bureau of Forestry.

While the new system is not yet in use by all turpentine operators, its application is extending as rapidly as the necessary equipment can be secured. At present there is but one company supplying the kind of cups and gutter iron required. It is hoped, since the demand for this material is very great, that in the near future the supply will be sufficiently increased to enable turpentine operators to procure the needed equipment.

While, in the work just completed, the Bureau of Forestry has performed an important service to the turpentine industry, it feels, nevertheless, that a still more conservative method of turpentining can be found, particularly one which, consistent with a maximum yield of turpentine, shall inflict the smallest possible injury upon the trees. With this in view the Bureau has begun an entirely new line of field experiments, in order to determine to what extent the wound now made in tapping the trees can be lessened.

Through the generosity and cordial coöperation of the Hillman Suthern Land Company, of Jacksonville, Fla., a stand of about 40,000 pine trees in Clay county, Florida, together with

other facilities, have, without cost to the Government, been placed at the disposal of the Bureau for experimental purposes.

The principal experiments now set on foot, comprise the practical working of a number of different turpentine crops. One set of trees will be used to determine, within practical limits, the best width of face to be cut on trees of different diameters.

Another set of trees will demonstrate, with approximate exactness, the rate in height, per streak, at which weekly chippings should proceed, in order to stimulate a full flow of rosin. It is believed that the weekly chipping now practiced cuts away in height, at one time, too much of the living wood; in other words, the face of the tree is increased too rapidly upwards. At present this upward chipping amounts to about 18 inches every year, and it is thought that this can be reduced at least one-half or two-thirds. Such a saving in face height will permit a considerable increase in the number of crop years, which, in turn, should give a much increased total yield of rosin as well as reduce the demand upon the area of pine forests. There will also be an economy for operators in having to move their equipment from one set of trees to another less frequently than is the case at present.

Still another set of trees will be devoted to finding out how deep toward the center of the tree each streak should be chipped. Under the present practice, it is believed that an unnecessarily deep cut is made, thereby greatly reducing the vitality of the tree and consequently its capacity to produce rosin continuously.

Blueberry Culture and Forest Fires.

In grazing sections throughout the West an old and well known custom is that of burning the dry grass to improve the next year's pasture. Formerly the fires were allowed to spread and burn themselves out at will, and the practice resulted in great forest destruction. Happily for the forests, the burning is now more carefully done when it is done at all, and on the whole the custom is falling into disuse. In Maine a practice of burning exists which is local to that State, is novel in character, and has nothing to do with grazing. The burning is to assist blueberry culture by causing the bushes to sprout vigorously and clearing the ground of other growth.

About 1870 a factory for canning blueberries was located in Maine, and as it prospered it was followed by others. In 1885 and again in 1899 similar factories and canning companies were established, until to-day blueberry raising and canning is an important industry in that State. To supply the increasing demand blueberry bush areas have been constantly enlarged, until now "blueberry barrens" cover some 2,600 acres in Hancock and Washington counties.

A century ago these "blueberry barrens" were for the most part covered by a dense forest, chiefly of white pine and spruce. The forest was thinned by lumbering the pine, and the increased amount of light permitted new kinds of undergrowth to get a foothold. Fire, as almost invariably happens, followed the lumbering, the rest of the original stand was destroyed, and the undergrowth was still further altered, a great variety of valueless underbrush and weeds taking possession of the ground, together with a stand of birch, popple, red maple, and other hardwood seedlings. As the fires continued to occur this hardwood growth changed to a very scrubby character and was finally entirely eliminated, and the ground became a true barren, covered with a growth of blueberry bushes, sweet fern, brake, bunchberry, goldenrod, and sheep laurel. With the ground in such condition its best use is for blueberry culture.

The blueberry owner divides his land into three portions; each year he picks the berries from one portion, burns another portion, and allows the third to rest. The first year after the land is burned over the blueberry

Skidding Logs in an Adirondack Forest in Winter.

bushes sprout and grow a few inches. The second year they yield a full crop of berries. The third season the crop is small and of little value, and the bushes reach a condition in which they can be burned most effectively.

Under this system of blueberry culture the land does not "run out" with constant use for the same crop. Where the burning has been properly done the same tracts have grown blueberries continuously for 50 years without showing any decrease in the yield. But if the land is burned over at the wrong time of the year, or the roots of the bushes are badly injured by fire, many years are required to restore the productive capacity of the tract. The best time for burning is when the melting snow leaves the ground wet and the tops of bushes dry. After May 10th burning is very injurious, unless the spring is exceptionally late.

The canning companies own most of the blueberry lands in Maine, except some small 25 or 30-acre private holdings. Pickers from company lands get 3 cents a quart, while private owners receive about 6 to 8 cents a quart for their berries. The picking season lasts six weeks. A rapid picker makes from $4 to $8 a day; if he has a large family to help him it is not unusual for him to make $600 or $800 in the six weeks. This makes the industry very popular among the pickers, and increases the danger that forest fires will be set or permitted to burn through good timber in order to increase the extent of blueberry barrens.

In addition to the 2,600 acres of present barrens, there are in Hancock county over 5,000 acres which have been reduced almost to a barren condition. Here, if necessary, this industry could be profitably extended. But when lumbering and fires have not materially depleted the forests, the land should be continued under forest cover, and the stand improved. The opportunity is ample for a proper extension of blueberry culture without invading valuable forest lands, which should be protected from fire. The wisest policy is to utilize the present blueberry barren areas to the fullest extent, and not to encroach further upon the forests, except as the growth of the industry makes it profitable to take old cut-over lands for this purpose.

Irrigation for the East.

The interest of Eastern agriculturists in the practice of irrigation is growing steadily. A recent editorial of the New York *Sun* is pertinent and deserves the attention of farmers and economists alike. The editorial in question is quoted in full:

"The irrigation of our arid regions has commanded much attention, but the system may profitably be extended far beyond them, though the understanding of its value is comparatively new to this part of the Union. A few truck and other farmers in New York and neighboring States have tried it for years, and they have found that irrigation in the East is profitable. A gradually widening circle of agriculturists has been brought over to this view. It is a little strange perhaps that our farmers generally did not take more rapidly to the idea, for they are only just beginning to repeat the experience of farmers in France, Switzerland and Italy, where some of the irrigated districts have a larger annual rainfall than the Mississippi Valley.

"During the past year the Department of Agriculture has been making investigations in our humid regions, particularly in the eastern part of the country. Its report, just published, deals almost exclusively with the irrigation of market garden crops. It was found that many of the market gardeners of Long Island, New Jersey and Massachusetts are beginning to discover that it is very profitable to irrigate their crops. In nearly every season there are periods of little rain during which the growth of vegetables is seriously checked. The proper application of water at these times prevents the diminution of the crops that would otherwise occur.

"At other seasons when the rainfall

is considerably below the normal, irrigation is an insurance against serious damage. These facts have now become so well established that the method is steadily extending among our market gardeners.

"Mr. Bach, of Flushing, in Long Island, who has thirty acres of garden truck under irrigation, estimates that the value of his crops was increased $5,000 last year by artificial watering. Mr. Rawson, of Arlington, Mass., says that the value of his market garden crops is often increased 50 per cent. by irrigation and nearly always as much as 25 per cent. The testimony is general that the size and quality of strawberries, onions, cauliflower and other small fruits and vegetables are much improved by irrigation.

"With the higher prices for crops and more intensive cultivation that are coming with increased density of population there is no doubt that irrigation will take its place as an important agency in the agriculture and horticulture of the eastern half of the United States."

Reclamation Service Notes. Mr. W. G. Swendsen has been appointed engineering aide in the United States Reclamation Service. Mr. Swendsen graduated from the Agricultural Colege of Utah with the degree of B. S. in C. E. in 1904, and during school and vacation months was engaged in various capacities as levelman and assistant engineer in the establishment of water works systems and the construction of pipe lines and canals, as well as reconnaissance work. He assisted the resident hydrographer in gaging streams and general repair work, and from April to December, 1904, was employed in the Reclamation Service on Strawberry Valley and Utah Lake reconnaissance work as transitman and levelman. He is now connected with the work in Utah.

The alumni of the Massachusetts Institute of Technology continues to be drawn upon heavily for engineers by the Reclamation Service at Washington. Among the recent additions to the personnel of the Government engineers are the following graduates of this institution: T. F. J. Maguire, a native of Massachusetts, as electrical engineer, with headquarters at Denver, Colo.; Howard Scott Morse, who for two years served as assistant in civil engineering of the institute, as assistant engineer in the Reclamation Service.

Ernest F. Tabor, who was appointed assistant engineer in the United States Reclamation Service last year, has been promoted to engineer.

Mr. Tabor attended the University of California, and since 1887 has been engaged in various capacities on engineering work in that State, chief amoung which are Superintendent for Escondido Irrigation District; location and construction of city water works for Elsinore, California; on river gagings, irrigation, mining and land surveys. He is at present engaged on reclamation work in Utah.

Horace W. Sheley, who since 1903 has been engaged in the work of the Reclamation Service, has been appointed engineering aide. Mr. Sheley attended Westminster College, Mo., and later the University of Utah, graduating with A. B. degree. He has assisted mining engineers and experts, and been engaged in bridge work as supervisor of construction of concrete and reinforced concrete piers and arches. Since entering the Reclamation Service Mr. Sheley has been employed as draftsman and topographer and in charge of plane table work. He is now connected with the work in Utah.

Daniel Grant Martin has been appointed engineer in the United States Reclamation Service, and placed in charge of work on the Minidoka project, Idaho. Mr. Martin attended the Kansas Normal College, and since 1891 has been engaged as engineer in various capacities on canal construction, in the State of Idaho.

Underground Waters.

A report has just been submitted to the Chief Engineer of the United Reclamation Service by Chas. S. Slichter, engineer in charge of investigation on the movement of underground waters, upon the underflow of the Rio Grande near El Paso, Texas, and Las Cruces, New Mexico.

Above the city of El Paso the Rio Grande passes through a narrow pass, or gorge, which the river has cut out of limestone rock. The river-bed is frequently dry at this point, and it became important to the growing community of El Paso and adjacent settled portions of the Rio Grande valley to know how much water was passing underground through the gorge of the river. The distance to bed rock at the gorge is about 90 feet, measured from the bed of the river. To this depth the channel which the river cut through the rock is filled with sand and gravel, through which the so-called "underflow" of the river moves. This term is now used to describe the ground water that is slowly moving downstream in the sands and gravels which lie beneath the bed of a river. In some river valleys the underflow constitutes a second and unseen river of considerable importance. In many cases the quantity of water that passes downstream in the gravels is very small, and consequently, of little value.

A few years ago Mr. Slichter invented and perfected for the United States Geological Survey a practical method of measuring the rate at which these underflow water move. This method has been put in use in many parts of the country, with much success, by means of which a great amount of valuable information has been collected concerning a matter about which engineers were formerly very much in the dark. The measurements are made by means of electrical instruments, the principles made use of in the method being quite simple. Small wells of two-inch pipe are first driven into the sand, one well being several feet downstream from the well first driven. Each well contains a few feet of perforated strainer at the bottom, and both wells are driven to the same depth. These small wells are very quickly driven and after use are pulled up and used again. After the wells are put in place, electrical connection is made from a battery to the wells, one pole of the battery being connected to the upstream well and the other pole of the battery being connected to the downstream well. The electrical current will then flow from the battery to the casing of one well through the water in the sand or gravel to the casing of the other well, and thence back to the battery. This current is at first very weak, and by putting a suitable instrument in circuit the strength of the current is automatically recorded on a chart or piece of paper that is moved by clockwork. When everything is in readiness, a strong solution of sal ammoniac is placed in the upstream well, which mixes with the groundwater around the strainer at the bottom of the well, and passes downstream with the movinggroundwater. This chemical when placed in water renders the water a good conductor of electricity, so that as the solution passes with the groundwater from the upstream to the downstream well, the electrical current continually increases and is recorded by the instrument. When the salt water finally reaches the downstream well and enters it through the perforated screen. A very simple device permits the current to still further increase, which shows on the record chart of the instrument the exact time at which the salt water arrived at the downstream well, and, hence, the time required for the underground water to move the distance between the upstream and the downstream well.

By means of these instruments, the rate of movement of the underflow at gorge of the Rio Grande was investigated. It was found by this means that the groundwater moved only 3 feet in 24 hours. The amount of underflow passing through the gorge was

Junction of Methow and Columbia Rivers, Washington.

Moses Lake Reservoir Site, Washington.

therefore very small. Unfortunately, the quality of the water at a depth of 35 feet below the surface was found to be very salty, and the water continually increased in saltiness until at 50 to 60 feet it was about as strong as sea-water. For this reason the underflow at this point is of little or no value.

A large number of tests of pumping plants in the valley of the Rio Grande were made, and the cost of irrigation by use of well water was carefully determined. The average cost of water from the pumping plants was about five dolars for each acre of water one foot deep. Test wells were drilled near Las Cruces, New Mexico, by means of which a determination was made of how much water could be safely drawn from the water-bearing sands and pravels of the valley without overdrawing upon the available supply.

Pike's Peak Polytechnic Society. This Society is composed of Civil Engineers and Surveyors, Mining Engineers, Mechanical Engineers, Electrical Engineers, Architects, Irrigation and Forestry Engineers, Geologists, Assayers, Chemists and others who are studying or practicing along technical lines.

Its object is the promotion of intercourse, observation and records in technical subjects, by means of periodical meetings, reading of papers, discussion, special investigation into matters of public and technical interest, the publication of such parts of the proceedings as should be deemed expedient, providing the convenience of a library and reading room for its members and the colletcion of books and periodicals on technical subjects. It is also the intention to secure the services of prominent specialists in various technical branches represented by the Society, to lecture before the members of the Society and invited guests.

The regular meetings are held on the second Saturday of each month in the Society's rooms in Coburn Library on the Colorado College campus. The annual dues for resident members are five dollars and for non-resident members, three dollars. There are at present eighty members in good standing. The following officers will serve for the year 1905: President, William Strieby; vice-presidents, B. H. Bryant, L. E. Curtis, W. F. Douglas; recording secretary, E. A. Sawyer; corresponding secretary, W. D. Waltman; treasurer, Ira A. Miller.

On December 1, 1904, Professor W. G. M. Stone, president of the Colorado Forestry Association, delivered an illustrated lecture on the "General Subject of Forestry." January 14, 1905, a general discussion on "Underground Waters" was led by Mr. E. C. van Diest, E. M. and Professor J. H. Kerr. On January 28, 1905, Mr. Clyde Leavitt, Government Forester, delivered an interesting lecture on the "Forestry Movement." A memorial is being prepared for presentation to the Colorado Legislature, urging the passage of the new forestry bill now before that body.

Any questions in regard to the Society or to technical matters in general in Colorado, will be cheerfully answered by the recording secretary or the corresponding secretary.

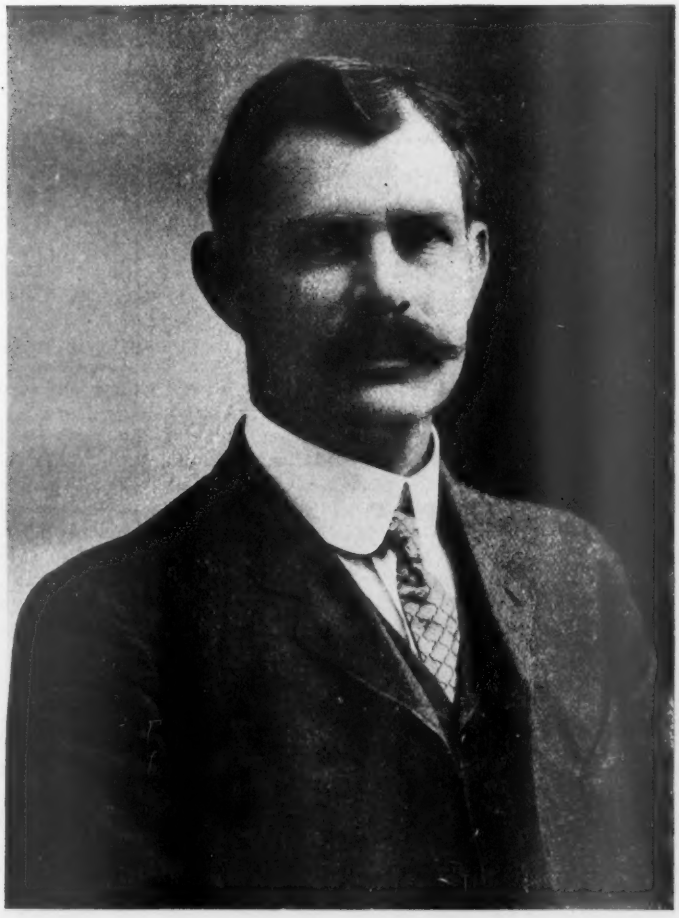
Canadian Forestry Journal. Realizing the want of a distinctive medium representing the Canadian Forestry Association, and to enlist public support, that Association has undertaken the publication of "The Canadian Forestry Journal," with Mr. R. H. Campbell as managing editor, and an editorial advisory committee including Dr. William Saunders, Prof. John Macoun and Mr. E. Stewart. The initial number of the magazine is pleasing in appearance, and contains several very interesting articles, together with a number of half-tone illustrations. Friends of the general forest movement will undoubtedly welcome this new publication. It is another evidence of the activity of the Canadian Forestry Association, and a move that should not only bring

added strength to the organization, but create much new interest in Canadian forestry.

Forest Reserves for New Jersey. In his inaugural address, delivered on January 17th, the Governor of New Jersey expresses his strong advocacy in the plan to establish State forest reservations in New Jersey, on the waste lands of that State. Governor Stokes says: "Every year the Government is spending thousands upon thousands of dollars in deepening the channels of our streams that are again promptly filled with soil carried by the rainfall from the treeless plains along the river banks. The same money expended in developing the forests along the streams and around the sources of their supply, would check the rush of water, save the soil that is now carried and deposited in the river channels, and reduce to a considerable extent the necessity for the river and harbor appropriations."

We are glad to note the appreciation of forestry by the chief executive of New Jersey. His plan for the regeneration of New Jersey is founded on sound, common-sense principles, and the revenue which the State should derive from forest products—a point which Governor Stokes illustrates with statistics showing the income of the State forests abroad—is a convincing argument. There are thousands of acres of land in New Jersey, part of it mere brush land, part of it abandoned and waste, all of it unsightly, and all capable of growing trees, that would beautify the landscape, afford attractive driveways, furnish places of recreation for the well and health resorts for the sick, and be a source of income to the commonwealth. Much of this land can be purchased for $1 an acre, and in some cases can be obtained for taxes.

The Celebrated Military Road which Crosses the Island of Porto Rico.



MR. MORRIS BIEN

Supervising Engineer, U. S. Reclamation Service.

One of the most effective members of the United States Reclamation Service is Morris Bien, supervising engineer. He is particularly well fitted for work in connection with the many intricate problems of national irrigation, owing to his having been educated both for engineering and the practice of the law. In addition, his work with the Reclamation Service was begun after nearly twenty-five years of experience in the government service, fifteen of which were in topographic work for the Geological Survey, and nearly ten years in legal work in the General Land Office. Morris Bien was born in New York, April 17, 1859, and graduated in civil engineering at the University of California in 1879, immediately securing employment with the United States Geological Survey in topographic work, which he continued until 1893. In 1895 he graduated in law at Columbian University, and in 1896 received the degree of Master of Laws from the National University. From 1893 until 1902 Mr. Bien was engaged in legal and right-of-way work relating to irrigation, railroads, etc., in the General Land Office. In July, 1902, after the passage of the National Reclamation Law, he was transferred to the United States Geological Survey, where he has since given his attention to legal and land matters with the Reclamation Service. Mr. Bien is a clear headed, practical man, who combines in a large degree those elements that have made the Geological Survey such a highly successful organization. Fitted by temperament and experience for reclamation work, he is rendering the country excellent service.

FOREST RESERVE MANAGEMENT TRANSFERRED

Control of the Reserves Passes from the Department of the Interior to the Department of Agriculture

ON February 1 President Roosevelt signed the bill shortly before passed by Congress having for its purpose the transfer of the administration of the federal forest reserves from the Department of the Interior to the Department of Agriculture. From now on the reserve work will be directly in charge of the Bureau of Forestry.

Since the creation of the first of our national forest reserves in 1891 the management has remained in the General Land Office of the Department of the Interior. The methods and organization of this bureau were not well adapted to the new problems which arose. The men assigned to the new division were able and faithful, but lacked the special education and experience needed in forest work. Furthermore, Congress held the purse strings tightly and thus hampered the possible development of better ideas. Nevertheless, the new division struggled determinedly with the puzzling questions that arose, and with the advice and assistance of the Bureau of Forestry and the U. S. Geological Survey, decided matters that were beyond the range of its own information.

In 1901 several trained men were detailed from the Bureau of Forestry of the Department of Agriculture to the reserve division of the Department of the Interior. It was hoped that in this way some plan could be devised for establishing practical forestry at once. A year of hard work proved conclusively that the intricate machinery devised for the adjustment of land titles was not suited for the prompt settlement of local questions in forest reserves two thousand miles from the seat of authority. President Roosevelt, the Secretary of the Interior, the Secretary of Agriculture, and the Commissioner of the General Land Office urged upon Congress the importance of making the transfer of the reserve management. The President said in his last message:

"As I have repeatedly recommended, all of the forest work of the Government should be concentrated in the Department of Agriculture, where the larger part of the work is already done, where practically all of the trained foresters of the Government are employed, where chiefly, in Washington, there is comprehensive first-hand knowledge of the problems of the reserves, acquired on the ground, where all problems relating to growth from the soil are already gathered, and where all the sciences auxiliary to forestry are at hand for prompt and effective coöperation."

On February 1 the President signed a bill which immediately transfers the pending business of the reserves, including timber sales, applications for the free use of timber, permits for grazing livestock, etc., to the Department of Agriculture, and all matters relating to such business will hereafter be referred to and administered by that department.

All officers of the forest reserve service, including superintendents, supervisors, and rangers stationed on the forest reserves throughout the West—a force numbering about 450 men—are transferred to the Department of Agriculture. The employees in this branch of the service were recently classified under the civil service act, and hereafter all applicants for positions in the forest service will be required to pass examination.

The rules and regulations relating to the free use and sale of timber and to the grazing of livestock will be re-

vised at an early date and such changes made in administrative authority and methods as will facilitate the prompt transaction of business upon the forest reserves. Until such revision is made, the present rules and regulations will remain in force, except those relating to the receipt and transmittal of moneys, in which case special fiscal agents of the Department of Agriculture will perform the duties rendered by the receiver of the local land offices in accordance with existing laws and regulations.

The vital importance of forest reserves to the great industries of the western states will be largely increased in the near future by the continued steady advance in settlement and development. The permanence of the resources of the reserves is therefore indispensable to the continued prosperity of the country, and the policy of the Department of Agriculture for their protection and use will be guided by this fact, always bearing in mind that the conservative use of these resources in no way conflicts with their permanent value.

All of the resources of the reserves, including the water, timber, and forage needed for the present and continued prosperity of the agricultural, mining, lumbering, and livestock interests, will be used in a businesslike way and with as little restriction as will insure a permanent supply of these resources.

The policy of the department in the regulation of grazing will be as liberal as compatible with the objects of the reserves. Every effort will be made to assist the stockmen to a satisfactory distribution of stock on the ranges, for the purpose of securing greater harmony, reducing the waste of forage, and securing a more judicious and profitable utilization of the range.

In the local management of each reserve all questions will be decided with a view to meeting the needs and demands of the people of that particular locality. The dominant industry of each district, whether it be agricultural, mining, lumbering, or grazing, will be fully recognized, and granted such privileges as will be consistent with the proper care of the reserves, and cause as little injury as possible to minor industries. The interests of the permanent settler will always be carefully guarded and every precaution taken to protect him against interests of a more temporary nature, since upon the successful establishment of homes depends the best and most permanent use of all of the resources of the forest reserves.

INFLUENCE OF TREE PLANTING UPON THE DUTY OF WATER IN IRRIGATION

BY

F. H. KING

Professor, University of Wisconsin

IN the effort to discover and establish underlying principles of agricultural science and to direct agricultural practice along lines which shall be in harmony with them, thus leading more directly and certainly to higher economic returns, we stand greatly in need of an increasing body of accurately determined fundamental facts; and it is very much to be hoped that it will be more and more recognized that the development of these fields falls properly within the purpose of Government aid and work. An adequate discussion of the broad problem of how to secure the maximum

duty of water in agriculture is not at present possible on account of lack of a sufficient body of well established facts; and this is especially true of that phase of the problem relating to the influence of tree planting upon the duty of water. The body of accurately determined facts regarding the influence of wind-breaks of any type upon the wind movement close to the surface, and especially upon the rate of evaporation from foliage, soil, and water surfaces, is extremely small, and yet such knowledge is necessary to a proper treatment of the subject. Some general facts and tendencies have been ascertained which are helpful for a preliminary consideration of this subject.

INFLUENCE OF WIND-BREAKS UPON VEGETATION.

There is no doubt but that under certain critical conditions wind-breaks do exert a very measurable influence upon vegetation. In the spring of 1894 (Bulletin 42, Wis. Agri. Exp. Stations) during May and June, an opportunity was afforded to make a somewhat critical study of this subject under field conditions. There is in Wisconsin an area of some ten thousand square miles of light sandy soil or sandy loam, and upon the lighter and more sandy portions of these soils crops are occasionally very seriously damaged by the drying effect of the wind; and the fertility of the soil is much reduced by the drifting which occurs at such times. At the time in question, there had been a heavy fall of rain on the 5th and 6th of May, but on the 7th it was clear and cold with a strong wind blowing from the northwest. During this and the following days, notwithstanding the rain, the soils on many fields about Plainfield and Almond, Wis., had been badly drifted. On the morning of the 8th the drifting had gone so far, on many fields, that at both places, the loose sand with which oats had been covered, whether with seeder or with drill, had been driven from the fields to such an extent as to leave the kernels entirely exposed and the plants lying flat upon the ground hanging by the roots and whipping in the wind. On the fields where the whipping had not been so severe and where oats stood 3 inches high, the oats had been cured like hay close to the ground, and even the leaves of dock sorrel were blackened and so dry as to crumble in the hand. Very many of the blades of oats, through wilting, had broken over close to the ground, presenting an appearance which suggested to the farmers that they had been cut by the sand. It was at once evident, to the most casual observer of the fields at this time, that wherever a field lay to the leeward of any sort of shelter the destructive effects of the wind were either not apparent or else they had not been nearly so severe.

About three weeks after the first serious injuries had occurred a careful study was made of many fields and the results are recorded in detail in the bulletin to which reference has been made. Some of the observations made at this time are cited here in illustration of the decisive evidence regarding the influence of wind-breaks upon vegetation. A north and south road 2 rods wide fenced with wire, along which are scattering trees 10 to 18 feet high, together with a scanty growth of hazel, had a field of oats lying to the east which was greatly damaged; but a strip 2 rods wide, next to the road, appeared wholly uninjured. A field of oats lying to the east of a field of timothy, in which there was a strong growth of dock sorrel, had a strip of oats 200 feet wide next to the grass where the stand was good, while on the eastern half, 30 rods wide, the plants were entirely destroyed. Another oat field having grass on the north and west sides, and bordered by a rail fence, showed a strip of uninjured grain 100 feet wide next to the two fences and fully 200 feet wide in the northwest corner of the field in the lee of the two fences. In another oat field fully five-eights of it had been so thoroughly destroyed by the wind that it was harrowed and

fitted for potatoes, but a strip along the rail fence on the south side, 150 feet wide, had been allowed to remain on account of the better stand, and on this area, as was usual generally, the number of plants increased as the fence was approached. To the west of this same field there was another of timothy, and adjacent to this there was a strip of oats 200 feet wide where the stand of plants was markedly better than farther away; and the same fact was observed in an adjacent field lying to the east of a closely fed pasture free from trees and shrubs. In another field 120 rods long from north to south and 80 rods wide, seeded to oats and clover, the effect of the surroundings upon the crops is indicated in fig. 1, where it will be seen that at a certain distance from the conditions which have influenced the temperature, humidity, and velocity of the wind, the oats had been very much injured and the clover had been entirely killed out.

In figs. 2 and 3 the condition of crops which were observed on other fields, and the surroundings which produced these differences, are also shown.

In fig. 2 the southeastern field is 80 rods long and 30 rods wide. Here it will be seen the oats were good along the road in the lee of the two fences, 40 per cent. gone further away, and entirely destroyed on the eastern half. Further north the field of oats adjacent to the field of grass and with woods to the north and in the distance to the west, had a good stand of plants, being seriously injured only at the south, where the wind came through between the two pieces of woods along the course indicated by the arrow. Similarly, in fig. 3, the influence of shelters are clearly and sharply brought about by the condition of the

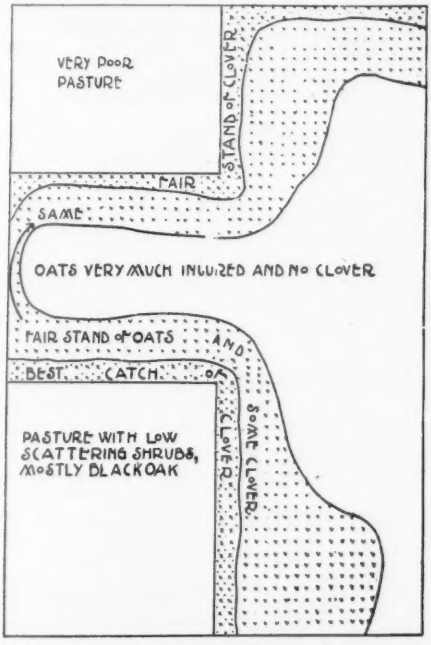


Fig. 1. Showing protected areas of oats and clover in the lee of woods and pasture.

crops observed and there recorded. The southern field in this figure was 60 rods from east to west and 30 rods wide. It will be seen that the half of the field stretching out into the path of the free wind coming through the gap between the two pieces of woods, as indicated by the arrow, has lost all of the crop, while the stand increased toward the woods on the west and was good at a distance of 10 to 20 rods from them.

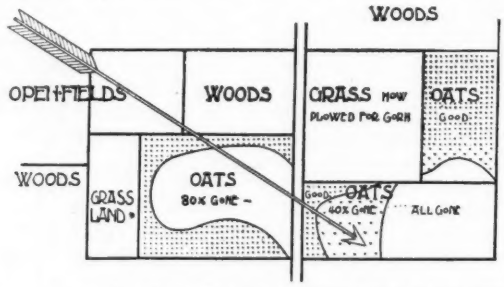


Fig. 2. Showing three fields and surroundings where oats had been entirely killed, together with areas protected from the wind.

The piece of oats lying on the south side of the scantily wooded pasture was in excellent condition, and although only 15 rods wide, a very appreciable difference could be seen in the stand of clover, to which the field had been seeded, on the margin most distant from the pasture. Even fields of corn stubble having fields of oats to their leeward were observed, in three instances, to have exerted very marked effects upon the stand of grain and in one of these fields, on one portion of the protecting corn stubble, there was a strong growth of dock sorrel. To the leeward of this part of the field the oats had been much less injured, suggesting that the effect of the humidity of the air passing across this may have been enough altered to render the wind current appreciably less destructive. Observations like these appear to place beyond doubt that, under certain conditions, at least, wind-breaks do exert a very measurable effect upon the vegetation of cultivated fields.

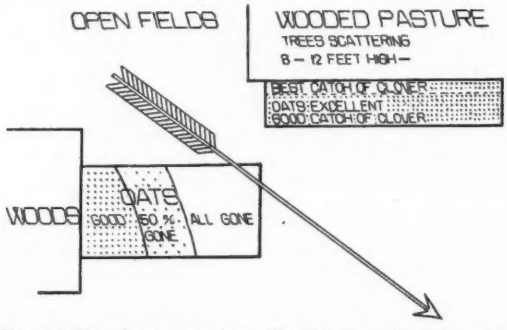


Fig. 3. Showing protection afforded to grain by woods and direction of destructive winds.

On three other oat fields which had been seeded to clover and which were bordered on the west with fields of grass, the number of clover plants upon unit areas which had survived

the effect of the wind was determined at different distances from and to the leeward of the fields of grass. The counts were made in series along east and west lines at right angles to the margins of the grass fields, and the results are given in the following table.

TABLE SHOWING THE DECREASE IN THE NUMBER OF YOUNG CLOVER PLANTS PER UNIT AREA WITH INCREASE OF DISTANCE TO THE LEEWARD OF THE MARGIN OF GRASS LAND.

Distance from margin of grass.	No. of Plants. Series 1.	No. of Plants. Series 2.	No. of Plants. Series 3.	No. of Plants. Total.
Feet.		Field No. 1.		
50	187	209	187	574
200	120	139	131	390
400	88	75	68	231
		Field No. 2.		
100	77	73	99	249
200	55	109	113	277
400	43	78	72	193
600	67	66	56	189
800	54	54	30	138
1000	27	11	10	48
		Field No. 3.		
50	377	382	371	1130
400	166	209	225	600
700	203	180	160	543

These three sets of data appear to leave little room to doubt that, in some manner, the grass fields to the windward of the fields seeded to clover did exert an influence which materially affected the stand of clover on them. In what manner this effect may have resulted will be referred to later.

INFLUENCE OF WOODS UPON THE RATE OF EVAPORATION TO THE LEEWARD.

At the time of the observations just described, others were made to measure the rate of evaporation at different distances to the leeward of woods, using a form of Piche evaporometer rendered more sensitive by increasing the diameter of the evaporating surface to 5.9 inches, thus giving an effective area of 27.06 sq. in., deducting the area of the water reservoir, the latter being graduated to .1, c. c. The instrument as placed in the field is represented in fig. 4.

Fig. 4.—Showing the form of Piche evaporometer as placed in the field.

With a series of 6 of these instruments set up in a line at right angles to the margin of a black oak grove having a mean height of 12 to 15 feet, the rate of evaporation which occurred simultaneously between 11:30 and 12:30 A. M. was measured, with the results given in the next table.

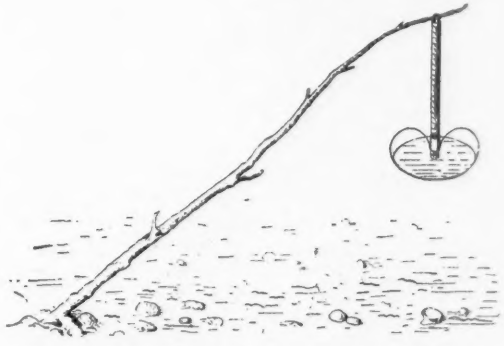


Fig. 4. Showing the form of Piche evaporometer, as placed in the field.

EVAPORATION ONE FOOT ABOVE THE SURFACE AT DIFFERENT DISTANCES TO THE LEEWARD OF A GROVE OF BLACK OAK IN A FIELD OF SANDY SOIL RECENTLY PLANTED TO CORN.

Distance from Woods.	Evaporation in One Hour.
Feet.	*C. C.*
20	11.0
40	11.1
60	11.3
80	11.2
100	11.9
120	12.9

These results show that until a distance greater than 100 feet is reached but little difference in the rate of evap-

oration was found. At 120 feet the evaporation was 17 per cent. greater than at 20 feet. Three of the instruments were next set up at 20, 40 and 60 feet, and at 280, 300, and 320 feet from the same grove and in the same field. During one hour the amounts of evaporation were as given in the next table.

EVAPORATION AT ONE FOOT ABOVE THE SURFACE AT 20, 40, 60, AND AT 280, 300, AND 320 FEET TO THE LEEWARD OF A BLACK OAK GROVE IN A FIELD OF SANDY SOIL RECENTLY PLANTED TO CORN.

Distance from Woods.	Evaporation in One Hour.	Distance from Woods.	Evaporation in One Hour.
Feet.	*C. C.*	*Feet.*	*C. C.*
20	11.5	280	14.5
40	11.6	300	14.2
60	11.9	320	14.7
Avrg. 40	11.66	300	14.4

From this table it is seen that the rate of evaporation was 23.4 per cent. greater at 300 feet than at 40 feet, basing the computation upon the averages.

In another locality the evaporometers were set up at distances ranging from 20 to 500 feet to the leeward of a piece of black oak woods where they had an average height ranging between 15 and 25 feet and were thicker on the ground. The results secured during an hour of sunshine in the middle of the day are given in the table which follows:

EVAPORATION ONE FOOT ABOVE THE SURFACE OF GROUND IN A FIELD OF OATS AT DIFFERENT DISTANCES TO THE LEEWARD OF A BLACK OAK GROVE OF TREES 15 TO 25 FT. HIGH.

Distance from Woods.	Evaporation in One Hour.
Feet.	*C. C.*
20	11.1
100	14.3
200	15.7
300	18.5
500	18.3

In this series the evaporation appears to have become constant at about 300 feet from the woods and was some 66 per cent. greater than at 20 feet distant.

The effect of a scanty hedgerow was also measured. This was composed of a strip of blue grass 16 feet wide in which there were scattered black and burr oak from 6 to 8, and occasionally 12, feet high. The hedge had open gaps in it and the nearest evaporometer was set up in the lee of a clump of 6 trees spanning a length of 40 feet, there being a gap of nearly equal length on either side. To the windward of this hedge there was a naked field 80 rods wide recently plowed and being planted to potatoes, and the instruments hung above the field of oats where the plants were about 4 inches high. The next table gives the results obtained.

EVAPORATION ONE FOOT ABOVE THE SURFACE OF A FIELD OF OATS AT DIFFERENT DISTANCES TO THE LEEWARD OF A SCANTY HEDGEROW.

Distance from Hedgerow.	Evaporation in One Hour.
Feet.	*C. C.*
20	10.3
150	12.5
300	13.4

In this case the evaporation at 300 feet from the hedgerow was 30 per cent. greater than at 20 feet, and 7.2 per cent. greater than at 150 feet, and the results make it clear that even scanty hedgerows exert a measurable influence upon the rate of evaporation at considerable distances to the leeward.

INFLUENCE OF A CLOVER FIELD UPON THE RATE OF EVAPORATION TO THE LEEWARD.

Adjacent to the naked field behind the hedgerow just considered, there was a field of clover 360 feet wide along the margin of the oats and extending 780 feet back from it, across which the wind passed in its course from the north. At the same time the last observations were made a similar series was taken to the leeward of the clover, the results being those given in the following table:

EVAPORATION ONE FOOT ABOVE THE SURFACE OF AN OAT FIELD AT DIFFERENT DISTANCES TO THE LEEWARD OF A FIELD OF CLOVER.

Distance from Clover Field.	Evaporation in One Hour.
Feet.	*C. C.*
20	9.3
150	12.1
300	13.0

These results indicate that at 300 feet to the leeward of the clover the rate of evaporation exceeded that at 20 feet 39 per cent. and that at 150

feet 7.4 per cent. Comparing the evaporation from the two adjacent areas where, as stated, the evaporometers were similarly and simultaneously exposed, it is seen that the air coming across the long stretch of naked ground and then passing through the hedgerow, caused measurably more evaporation than did the current which had traversed the field of clover; and these results appear to be in complete accord with the observations cited regarding the stands of grain and clover to the leeward of woods, hedgerows, grass fields and shelters of other kinds.

INFLUENCE OF WOODS AND GRASS FIELDS UPON THE HUMIDITY OF THE AIR TO THE LEEWARD OF THEM.

At the same time that the several sets of observations were taken and at the same places, others were also made with wet and dry bulb thermometers of the Henry J. Green make, reading to tenth of a degree C. The results obtained are given in the following table, each value being a mean of 10 readings, which were made in regular rotation, passing from station to station of each series during the intervals of exposure of the evaporometers.

RELATIVE HUMIDITY OF AIR THREE FEET ABOVE THE SURFACE AT DIFFERENT DISTANCES TO THE LEEWARD OF WOODS, HEDGEROWS, CLOVER FIELD AND NAKED SOIL.

Distance to the Leeward.	Mean Dry Bulb Readings.	Mean Wet Bulb Readings.	Mean Relative Humidity.
Feet.	*Degree F.*	*Degree F.*	*Per cent.*
	Grove No. 1.		
30	65.32	49.46	27.0
300	63.80	47.35	24.0
	Grove No. 2.		
20	75.04	58.35	34.6
100	73.13	56.39	33.0
200	72.03	55.83	34.2
300	71.47	55.13	32.8
400	73.63	55.63	29.6
500	73.31	55.94	30.8
	On Leeward Margin of Clover Field.		
0	52.48	43.97	48.0
	On Leeward Margin of Naked Field.		
0	53.24	43.57	44.0

These four series of observations, although too limited to serve as the basis of general conclusions, are, in a general way, quite in accord with the records of evaporation which have been cited, and also in harmony with the very pronounced observed protection afforded to oats and clover to the leeward of the various shelter conditions which have been cited. To my own mind, however, the surprise lies in finding such profound differences in crop conditions associated with the observed differences in meteorological and surface conditions. It should be borne in mind, however, in considering these relations, that the meteorological observations were not made at the time the destructive work was going on; hence what differences then existed are not known. The relations which have been observed and pointed out are clearly vital to the reclamation problems of the arid and semi-arid West, and merit full investigation, especially from the standpoint of field conditions.

The very marked influence which has been observed upon the stand of both oats and clover under the conditions cited is undoubtedly, in large measure, due to the character of the soil and to the stage of growth of the crops, the wind coming at a time when the root system of the plants was yet scantily developed and very close to the surface; but the measurable differences in the stand of clover, at such long distances from the conditions which have evidently produced them, leaves little reason to doubt that crops are sensitive to such differences of temperature, humidity, and velocity of the air near the surface as must result from the conditions whose types have been here considered. There can be no doubt that rows of trees along canals and about reservoirs must very materially reduce the loss of water through evaporation from their surfaces, and such observations as have been cited make it hopeful that their influence upon the loss of moisture from adjacent fields and their effects upon crops themselves may be of much greater importance, especially in plains regions; but only fuller investigations can make certain the true relations.

WIDTH OF THE ZONE INFLUENCED BY WIND-BREAKS.

Newell ("Irrigation," by F. H. Newell, page 370), in speaking of the influence of wind-breaks on plains, states that: "It is estimated that every foot of height of compact trees protects a rod of ground; hence a Lombardy poplar wind-break of an average height of 60 feet, properly set out, has a beneficial influence extending practically 1,000 feet to the leeward." In the cases which have been cited the rate of evaporation and the humidity of the air were measurably affected at distances having the same or perhaps a little higher order of value; but when the effect upon the crops themselves is taken as an index, the influence clearly has a wider range, there being in the case of the fields seeded to clover so strong a contrast as 183 to 48 between the distances of 800 and 1,000 feet to the leeward of a grass field, where it appears that the influence must have been exerted in some manner other than by directly modifying either the wind velocity or the humidity of the air. It appears possible that broad continuous naked fields of dry soil or sand on clear days may have a peculiar effect upon air currents sweeping across them. The dry soil or sand itself under such conditions becomes heated and tends to expand the air lying in contact with it, making it relatively lighter than the much cooler and more rapidly moving currents above, and it may be that when these conditions are established the warm air is displaced by the heavier, cooler, and more rapidly moving air from above. Such a current from above, aside from its higher velocity, would be likely to exert a peculiarly parching influence as its temperature rises after coming in contact with the soil. Grass-covered surfaces and damp soil could not be expected to have this effect in so marked a degree, and the result may be that during windy times the air moves across damp surfaces and fields of grass in a less turbulent manner, and as a consequence maintains a higher humidity, which reduces the parching effect. If, however, the turbulency of the air currents at the surface of the ground increases their parching effect, it may be asked whether wind-breaks on plains may not augment the turbulency of the currents and thus, while exerting a protecting influence over a certain distance to the leeward of them, they might not lower the duty of water in the district as a whole and have a prejudicial effect upon average crop yields. Indeed, it appears quite possible that if the wind-breaks were placed too far apart such an effect might be the result, but hardly otherwise. But, even if wind-breaks do exert in general a beneficial effect and tend to increase the duty of water, exact observations are yet too limited to indicate whether the magnitude of such influence would be sufficiently great to make their establishment an economic investment, much less to permit an estimate to be made of what returns might be expected from such an investment. But the problem is capable and worthy of solution.

RATE OF EVAPORATION FROM WATER SURFACES.

There is already a considerable body of data accumulated in this country which indicate the magnitude of the rate of evaporation from water surfaces. A portion of this data has been obtained by measuring the loss of water from tanks floating in reservoirs or canals, but most of them show the loss from tanks three feet square or in diameter and three feet deep, set in the ground so that the rim is within 12 inches or less of the general surface. The mean evaporation during the growing season, April 1 to October 31, as indicated by the records of nineteen stations located within the rectangle 103° and 121° of longitude and 32° and 43° of latitude, is .21 inches per day, 21.149 inches per 100 days, and 47.358 inches for the 214 days in the period under consideration. The minimum evaporation at any stage indicated in the records was .14795 per day, 14.795 per 100 days, 31.66 inches

for the seven months; while the maximum (not including two at Wheatland, Wyo., which appear to be exceptional) was .273 inches, 27.295 inches per 100 days, and 58.41 inches, or close to 5 feet, for the seven months, at Logan, Utah. East of the Mississippi we have access to records from but five stations in the rectangle 71° to 90° longitude and 39° 30′ and 44° 30′ latitude, and the mean evaporation has been .145 inches per day, 14.533 per 100 days, and 31.1 inches for the seven months. The records obtained at Boston, Mass., and Rochester, N. Y., are from floating tanks and the mean evaporation was at the rate of 12.09 and 11.448 inches per 100 days, respectively.

In the absence of fuller data, it is perhaps permissible to assume that the ratio of evaporation at 20 feet and 300 feet from the woods, as observed with the Piche evaporometers, is the same as would have been found from water surfaces had they been similarly placed. The mean of the three sets of observations with the evaporometers indicate that the evaporation at 300 feet was 40.73 per cent greater than at 20 feet. If we consider the probable saving of water by wind-breaks, it appears likely that, except in the cases where the trees exclude the sun from canals or reservoirs, the 40 per cent represents the maximum saving which could be expected from wind-breaks. With an evaporation of 47.358 inches, given as the mean above, the maximum probable saving would be 18.94 inches of water from a canal or reservoir.

EVAPORATION OF WATER FROM CONTINUOUSLY MOIST SOIL.

During the summer of 1903, a soil evaporometer having an evaporating surface of 11.7 square feet was maintained at each of four stations: Goldsboro, N. C.; Upper Marlboro, Md.; Lancaster, Pa., and Janesville, Wis. The soil surface was kept continuously capillarily saturated by maintaining a water level in the soil at about 12 inches below the surface, from which an autographic record was secured in each case. The mean evaporation, per 100 days, at the several stations was found to be 21.2, 15.3, and 18.0 inches at the four stations, respectively, given in the order above, or an average of 18.43 inches per 100 days, and of 39.43 inches for April 1 to October 31. If the mean evaporation from similarly moist soil surfaces in the arid regions holds the same relation to that in the humid region as is indicated by the relative rates of evaporation from water surfaces in the arid and humid regions, the total evaporation from a constantly moist soil would average 60.04 inches instead of 39.43 inches, the mean found at the four stations east of the Mississippi during the growing season, computed to 214 days. If five feet is the mean rate of evaporation from continuously moist soil in the West, the maximum saving through wind-breaks would be, according to the observations cited, some 40 per cent of the total, or 24 inches. It is, of course, never true that the surfaces of fields are maintained continuously as moist as was the case under which the rate of evaporation has been determined. It is true, however, that during the time water is being applied in irrigation and for some considerable time thereafter, the rate of evaporation will exceed that which has been recorded from the surfaces kept capillarily saturated from a water level one foot below; and irrigators recognize the fact of rapid evaporation during the hot portion of the day through the notably less distance water will travel under a given head before sinking into the ground, than is the case at night and when it is cool.

COMBINED EVAPORATION FROM SOIL AND CROP.

At each of the places where the soil evaporometers were maintained, and at the same time, an entirely similar one filled with the same soil matured ten stalks of maize. The water level in these evaporometers, however, was maintained at 3 to 3.5 feet below the surface, instead of at 1 foot, and an autographic record of the evaporation

was obtained. The time between planting and harvesting averaged 120 days, and during this time the mean total evaporation amounted to 24.15 inches, or a rate of 20.13 inches per 100 days and a total of 43.08 computed to 214 days. On these evaporometers the mean yield of dry matter per acre was 13,881 pounds, 10,000 being a large field yield. This observed mean rate of evaporation is, therefore, likely to be some higher than for ordinary field yields under the same climatic conditions, and the indications are that the evaporation from the field surface under crop may not be quite as large as has been found from the continuously wet soil surface. It may appear impossible that such a relation as this can exist, but the probability of it being true is made clearer when it is understood how great is the reduction in the rate of evaporation from soil surfaces when a thin layer at the top is allowed to become dry, and especially if it is loose and in the condition of an earth mulch. The surface of the soil in the plant evaporometers was maintained in the condition of a good earth mulch three inches deep, and the effectiveness of earth mulches is clearly brought out by the results given in the following table, where the mean amount of evaporation from firm and mulched surfaces of six soil types are given:

EVAPORATION FROM SIX SOIL TYPES DURING 28 DAYS WITH SURFACES FIRM AND UNDER THREE-INCH EARTH MULCHES, COMPUTED TO 214 DAYS—SEVEN MONTHS.

Soil Types.	Surface Firm.	Surface Under Three-inch Mulch.	Difference.
	Inches.	*Inches.*	*Inches.*
Sandhill.....	14.37	1.57	12.80
Selma Silt Loam...	22.13	5.92	16.21
Pocoson	25.64	7.11	18.53
Norfolk Sandy Soil.	31.87	5.89	25.98
Goldsboro Compact Sandy Loam.....	40.85	6.73	34.12
Norfolk Fine Sandy Loam.....	49.79	8.70	41.09

These observations were made at Goldsboro, N. C., in June and July, and they show that there is a very great protection against evaporation afforded by three-inch earth mulches; also, that there is a large variation in the loss of water from different soil types under like conditions through surface evaporation. As the data of this table were obtained during a comparatively dry period, and when the temperature was high, the rates and differences are perhaps as large as are likely to occur, on the average, in the irrigated districts of the West, under such conditions.

In another series of observations made under what must have been conditions closely similar to those of arid climates, columns of capillarily saturated soil 10 feet long were maintained under a continuous draught and without moistening the surface, during 314 days where the temperature ranged between 60° and 90° F. The loss of water which occurred was only determined percentagely, but from the weights of the soils per cubic foot the total evaporation, computed to 214 days, must have been very close to the amounts in the next table:

EVAPORATION FROM TEN FEET IN DEPTH OF TWO SOIL TYPES UNDER ARID CONDITIONS CONTINUOUSLY DURING 314 DAYS—AMOUNTS COMPUTED TO 214 DAYS.

Soil Types.	Surface Firm.	Surface Under Three-inch Mulch.	Difference.
	Inches.	*Inches.*	*Inches.*
Sandy Loam.....	2.85	2.49	.36
Heavy Clay Loam..	6.55	4.65	1.90

From these observations, and those given in the last table, it is clear that whenever the surface of a field is protected by a layer of dry soil, whether this is firm or loose, the evaporation will be relatively small; but less from the loose than from the firm surface.

It is probable that the losses of water by evaporation from fields in the irrigated districts of the western United States ranges all the way between 1.57 inches and 50 inches from April 1 to October 31. If this is the case, the maximum conservation of soil moisture, through wind-breaks, is likely to be found to lie somewhere between 40 per cent of 1.57 inches and of 50 inches, or between .63 inches and 20 inches for the period April 1 to October 31.

The wind-breaks themselves, of course, transpire not inconsiderable

amounts of water; but when they are planted about reservoirs and along canals, laterals and head ditches, they may draw largely upon water that would otherwise be lost through percolation or seepage; moreover, the land which such wind-breaks would occupy is often, in part at least, necessarily waste land unless used in this manner. But if it shall be found practicable to make the wind-breaks by using fruit or nut-bearing trees so that an annual income will be realized from them, even though it must be small, the promise of a good investment along this line becomes much better.

THE NEW IRRIGATION

(An Apostrophe to El Dorado)

Oh! golden land of Ophir!
Oh, pleasure ground of gain!
Where earth's remotest loafer
Seeks Paradise in vain!
Where coin is current tender,
And greenbacks are a drug,
And money pays the lender
A profit mighty snug!

Whose roseate buds of Sharon
Develop into bloom
Amid vast deserts barren
And prehistoric gloom,
While shares of gold and silver,
Like waves upon the sea,
Take up-and-downward motion
To be or not to be.

I fain would sing thy praises
In all-praiseworthy song;
But better homely phrases
Than flavored words of wrong.
For nowhere in the nation
This pleasure ground of gain,
Effects of irrigation
So long and fast remain.

Just ask the jolly rounder
Who wets his whistle down:
Go ask the truth expounder
Or men of great renown.
Oh! wondrous land of Ophir!
And yet so scarce of rain!
The tramp will have to go far
To find thy like again.

CHARLES HALLOCK.

TEACHING ELEMENTARY FORESTRY

Washington Schools Giving Instruction in Forestry in a Way that Should Become Observed Throughout the Country

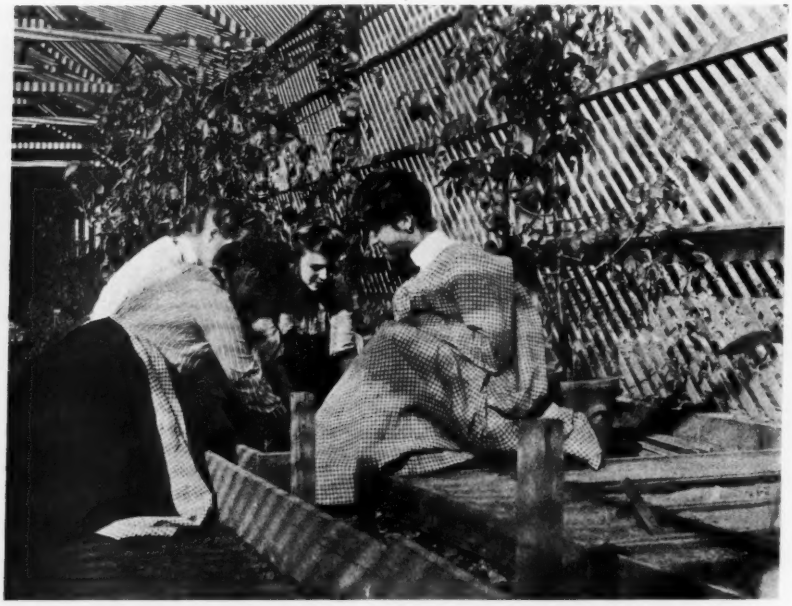
BY

SUSAN B. SIPE

Instructor in Botany, Normal School, Washington, D. C.

AMONG the resolutions adopted by the American Forest Congress, held in Washington recently, was the following: That all schools, especially rural, should study forests and tree planting in their effect upon the general well-being of the nation, and in particular upon the wealth and happiness of communities through the modification of local climate.

Strange as it may seem, educational movements that most affect the rural schools originate in city schools. We find the city teacher demonstrating to the rural teacher the best lines of development for the rural child. In all branches of manual training, household economics, and school garden work this has been strongly illustrated. We now find the city schools encouraging and working out plans as a forerunner of the larger work that will be done in the future in the for the study of elementary forestry rural school. The beginnings of this work may be seen in Cleveland, Rochester, Joliet, Ill., and in the Normal School of the District of Columbia.



Normal students stratifying seeds in sand to carry them through the winter. The seeds are collected in the city parks.

On the same principle that there must be trained foresters for the broad subject of forestry, so the teachers of the elementary schools must have instruction sufficient to arouse their interest in tree planting, in tree culture, and tree protection, if only in connection with the shade trees of cities, that the children assigned to their care may be taught the same. In connection with its course in botany, the Normal School at Washington is giving its student-teachers such instruction. Considerable attention is given to the identification of the city's trees and those of the surrounding country. There is a woeful lack of knowledge on the part of the young of the names of the commonest trees. To remedy this much outdoor work is done in the parks and suburbs. Attention is given to the winter identification as well as the summer one.

The physiological side of the subject is considered, so that trees will be regarded as living things having struggles for existence. Attention is likewise called to the interdependence of tree life, birds, man, and insect life, the insect enemies and their prevention. Tree protection, in so far as it touches the city child's life, are included in this course.

Permission is granted the students to collect tree seeds in the parks during the fall season. These are stratified in sand to carry them through the winter for spring planting. Only such seeds are collected as will produce trees suitable for school ground planting later, as it is the purpose of the Normal School to supply trees to the city schools in a few years. Through the co-operation of the Bureau of Plant Industry the school is allowed the use of land in the experiment garden conducted by the Bureau on the Potomac Flats. The students, who are all young ladies, do all of the work, marking the rows, preparing the

Normal students laying off a seed bed.

Preparing the ground by means of a hand-plow.

Weeding the seed bed in July. About five hundred seedling oaks, walnuts, and Kentucky coffee-trees ready for transplanting in spring. The trees will be distributed to city schools.

land by means of a hand plow, planting, and weeding the seed bed during the summer. About five hundred seedling oaks, walnuts and Kentucky coffee trees are ready to be transplanted to nursery rows this coming spring. Bulletin 29 of the Bureau of Forestry is the text-book followed in this work. Lectures are given on turpentine orcharding, the wood pulp industry, lumbering in various parts of our country, destructive lumbering, forest reserves, forest schools and the work of the Bureau of Forestry, illustrated by slides loaned by the Bureau.

The effect of this is felt in the city schools. The graduates of the Normal School are appointed to teach in the first grade. Among the first lessons they give to the little ones is one on the trees immediately in front of their respective school buildings, followed by others in the neighborhood. The children watch these trees throughout the school year, noting all the changes that take place. This work is repeated in the second grade and again in the third.

Correlation of this work with the geography of any grade is accomplished whenever possible. The story of a pine board, life in a lumber camp, past and present methods of obtaining turpentine, the relation of forests to water supply, are familiar facts to a sixth grade boy in Washington.

The Forest Congress did well to suggest this instruction in the elementary schools. When the day comes, as it must come, that the training of the public schools will fit a boy for the vital problems of living, the training of the future forester will begin with his first years in school. The popular knowledge thus spread by the graded schools among the masses will rapidly accomplish the purpose of the Congress. This, too, establishes the place, and a very valuable place, of woman in forestry—that of the teacher.

Portion of class at work planting seed.

THE RECLAMATION SERVICE

Progress of Leading Projects---Land Withdrawals---Letting of Contracts

Shoshone Project in Wyoming.

ON the main thoroughfare leading into the Yellowstone National Park from the east, in a region of wild and wonderful topography, the Government engineers are engaged upon an irrigation project which is destined to convert a vast area of desert into fertile and productive farms. The main area of land to be irrigated is located in the northern portion of the so-called Big Horn basin, on the north side of Shoshone River, seventy-five miles east of the Yellowstone Park.

Field investigations and surveys were begun on this project in May, 1903, and have been carried on since by Mr. Jeremiah Ahern, district engineer. The reclaimable area is approximately 200,000 acres, located on both sides of the Shoshone River below the canyon. The land is of general good quality and, as shown by large areas already under cultivation in the immediate vicinity, will be highly productive when irrigated. The Shoshone River, which furnishes the water supply, has a drainage area of 1,250 square miles extending into the mountains to an elevation of over 12,000 feet. Measurements and gagings of the river have been maintained since 1892, and show a mean annual run-off of about 1,000,000 acre-feet, with maximum floods reaching up to 15,000 cubic feet per second or more in the early summer, and running down to 250 cubic feet per second or less during the winter. The great variation between the maximum and minimum flow necessitates impounding the flood run-off to secure a regulated supply for the irrigation of large areas. An excellent storage reservoir site has been found on the main stream at some distance above the land to be irrigated, the dam site being in a granite canyon. Just below the junction of its two main forks the Shoshone River enters a very narrow canyon, four miles in length, one mile of which is in solid granite walls rising nearly perpendicular several hundred feet. At the point selected for the dam the canyon is 65 feet wide at the bottom, and at an elevation of 240 feet, the height of the proposed dam, 180 feet wide. The reservoir created by the dam will have a storage capacity of 580,000 acre-feet. Owing to the perpendicular canyon walls, it will be necessary to design a tunnel to provide for the discharge of a wasteway for excess floods to pass the dam.

This tunnel will be constructed from the surface of the proposed reservoir through the solid granite of the mountain, and will discharge the water into the river several hundred feet below the dam. The capacity of the tunnel will be 25,000 cubic feet per second, ample to carry the largest floods of the stream. The outlet works will have a capacity of 2,500 cubic feet per second, the discharge being through a tunnel excavated in the solid granite walls of the mountain at an elevation of 60 feet above the stream bed. The tunnel will be 14 feet square, discharging under pressure, and will be controlled by a series of gates at the intake end. As originally designed, 150,000 acres on the north side are to be supplied through a simple high line conduit having a total length of about 75 miles, decreasing in carrying capacity as distributory canals are taken out.

The first three and a half miles of the main canal will be through the canyon and mostly in tunnel, the remaining distance by canal, which at the head will be 60 feet wide on the bottom with water eight feet in depth. Diamond drill borings were begun at the dam site in August, 1903, to determine bed rock conditions, depth, etc.

The preliminary investigations seem to indicate that bed rock would be found close to the surface, but the diamond drillers discovered an altogether different condition. From the very first large boulders and heavy gravels were encountered, and the drills penetrated to a depth of 88 feet before bed rock was reached. This unexpected depth to foundation will increase the expected time to finish the storage dam by at least two years, since the loose material at the bottom of the canyon will all have to be excavated in order that the masonry work of the dam can be erected on bed rock throughout. As the canyon is exceedingly narrow, it will be feasible to inclose the entire area to be covered by the dam, and including the dam itself. This inclosure can then be heated so that the work may be carried on during the winter season. In order to handle the water which will be encountered by excavating the foundation for the dam, an unusually large construction power plant will be required.

Exceptionally good local conditions for such power development exists here by using the water in the stream and natural channel through the canyon, or by the use of a steam plant, the fuel for which recently has been found within ten miles of the work. The reclamation of 150,000 acres of land through the construction of this work will add a population of approximately 50,000 inhabitants to what is now a very sparsely settled community.

North Platte River, looking downstream from just above dam site at Pathfinder Reservoir, Wyoming.

The Pathfinder Project.

The investigations on the Pathfinder project began in April, 1903, and have been pushed energetically ever since. The preliminary work has reached a point where contracts have been let for a portion of the work and actual construction will be started in a few weeks.

The Pathfinder project contemplates the storage of the flood and surplus waters of the North Platte River in an immense reservoir, which will be made by constructing a high dam in a narrow canyon of the stream. The annual discharge of the river is approximately one and a half million acre feet, and the reservoir will be capable of holding back all the surplus and flood waters of the entire year. It is proposed to hold back the floods until the irrigation season, when the water will be permitted to flow down the channel of the stream for a number of miles, and thence be diverted by a low diversion dam into canals, which will carry it upon the lands to be reclaimed.

This reservoir will serve a double purpose; it will eliminate for all time the destructive annual floods of the stream, and will furnish an abundant and perpetual water supply for a vast area of land now desert and worthless. The canal system required for this project will be the longest in the United States, the main canal having a total length of 140 miles, and supplying lands in two states, Wyoming and Nebraska. The reclaimable area has not been finally ascertained, but the present surveys indicate a total of 300,000 acres that can be easily supplied.

As in case of all government projects, complications of prior rights and private ownership have been encountered, some of these interests being exceedingly powerful and disposed to obstruct the progress of the work. The citizens of both states almost without exception are urging the Government to proceed, and it is believed in view of the attitude of the public that these complications will be removed in a short time. The lands to be reclaimed are of great fertility and adapted to a wide variety of products. Above the canal line and extending for many miles in both states is a vast range furnishing free grazing for thousands of cattle.

Diamond Drill Work.

One of the most essential details connected with the preliminary investigations of a large Government irrigation project is the work of the diamond drillers. As soon as the reconnaissance surveys indicate a feasible project the diamond drill outfit is sent out to discover the availability of the dam site. In all cases where dams are to be built it is absolutely impossible to determine the number of yards of excavation to bed rock until careful examinations have been made with the diamond drill. The final plans of a project, estimates of cost, the kinds of structure—in fact, nearly all the important features connected with the work—are dependent upon the results of the borings. It frequently happens when the borings are completed that all the preliminary plans must be altered. Occasionally the whole project is abandoned.

The high structures which the Government is erecting must rest upon solid foundations. Melting snows or cloudbursts on the mountains embraced in watersheds covering thousands of square miles rush down steep slopes and converge in the narrow channels of these pent-up rivers. The floods beat with almost resistless force against the impounding dams that block the way. They must be constructed as firm and as enduring as the everlasting mountains from which they are being hewn.

The eye of man alone cannot safely determine the location of the immovable rock upon which these great structures must be builded. Surface indications offer no safe guide; but the diamond drill, penetrating the gravels, boulders, shales, and shattered formations, finds at last the permanent base. An example of the fallibility of superficial investigations of dam sites was

shown recently during the preliminary reconnaissance of the Shoshone project in Wyoming. At the point selected for a dam the river had cut through a deep and narrow granite canyon and apparently flowed over rock of the same formation. All indications were that bed rock would be found at a depth of ten feet maximum. On putting a drill at work, however, it was shown that bed rock was 88 feet below the bed of the river. What looked to be a thin layer of gravel proved to be 88 feet of gravel and slabs that had fallen from the canyon walls, some of these being 30 feet in thickness.

North Platte River, looking upstream from Dam site at Pathfinder Reservoir, Wyoming.

At one diversion site on the North Platte River, where conditions seemed favorable for bed rock at 25 feet, borings to a depth of 90 feet failed to find it. The borings did show, however, that there was 30 feet of gravel and boulders underlaid with soft material —quick sand—which would not permit the building of a heavy structure. On the Colorado River a desirable site was discovered, so far as the surface conditions indicated, where a point rock stood ten feet above the water surface. Two hundred feet away borings 120 feet below river bottom failed to find solid foundation. In a great many cases a few hundred dollars expended in borings have resulted in changing the location of dam sites, and, of course, have saved many thousands of dollars.

The same conditions hold good in the examination of reservoirs, where natural depressions are used to store

water. Here it is necessary to determine whether the bottom is impermeable or whether it has a subterranean outlet which would let the water out after it had been stored.

Uncompahgre Bids Rejected.

The bids received by the Department of the Interior in response to advertisement of November 28, 1904, for the construction of a frame building at Montrose, Colorado, for the use of the Reclamation Service, have been rejected by the Secretary of the Interior. The bids were as follows:

Hansen & Nissen, Denver, Colo., $7,969.00; E. B. Johnson, Denver, Colo., $6,782.00; J. H. Antrobus, Montrose, Colo., $6,223.20; M. A. Masters, Montrose, Colo., $6,043.26; H. A. Meredith, Montrose, Colo., $5,690.00.

In view of the fact that the lowest bid was in excess of the amount set aside or believed to be necessary for the construction of the building, the Secretary has ordered that new plans and specifications be prepared and new proposals advertised for.

Contracts Awarded In Arizona.

The Secretary of the Interior has awarded contracts for furnishing 50,000 barrels of fuel oil, and hauling same and miscellaneous freight from Mesa to Roosevelt, Arizona, in connection with the Salt River project, in that territory.

The contracts were awarded to the lowest bidders, as follows: C. R. Eager & Co., of Los Angeles, Cal., for furnishing and delivering oil at Roosevelt, Ariz., at $3.98 per barrel; Wolf Sachs, of Tempe, Ariz., for hauling miscellaneous freight from Mesa to Roosevelt, Ariz., at $13.60 per ton. The Secretary fixed the amount of bond to be supplied under the oil contract at $15,000, and under the hauling contract at $5,000.

Notes on Oregon Reclamation Work.

Land owners under the Malheur project in eastern Oregon are becoming each day more desirous of early action by the Government on this work. The Water Users' Association has worked out a form a agreement to arbitrate the value of present ditches and water rights, but much yet remains to be done to insure early construction.

Field work under the direction of Engineer J. T. Whistler was completed during November, and the force is now busily engaged in making drawings and computations. Work with diamond drill at diversion dam site was completed December 24.

Work on the Carty reservoir site, in connection with the Umatilla project, was completed during November. It is estimated that over 200,000 acre feet can be stored at a cost which will probably not exceed $10 per acre foot.

A preliminary canal line was surveyed from this new reservoir site to John Day River, and levels carried some distance up the river. The river runs in a more or less abrupt canyon from 500 to 1,000 feet deep. In the lower part of its course the canyon is not so precipitous, and it is possible a project may be evolved at a cost of from $30 to $40 per acre irrigated.

The feed canal line will be 75 to 100 miles long, but with the water supply from this source all the land which falls below the canal can be easily watered. While under this scheme there will be from 25 to 50 miles of heavy rock work, it is desirable if possible to utilize this source of water supply, that the waters of Umatilla River may be left for lands to the east and north of the stream at some later period when they have become more valuable.

Several gaging stations were established in the State of Oregon during the month of December for the purpose of securing data as to stream flow in connection with projects investigated last season in the interior of the state.

Land Withdrawals.

Pending further investigation, the Secretary of the Interior has temporarily withdrawn from any form of disposition whatever the following de-

scribed lands in the State of North Dakota for irrigation works in connection with the Buford-Trenton project: Fourth principal meridian.—T. 150 N., T. 100 W.; Sec. 21—N. E. ¼ N. E. ¼.

Pending further investigation, the Secretary of the Interior has withdrawn from any form of disposition whatever the public lands in the State of Montana in connection with the Madison River project, as follows:

Montana principal meridian.—T. 1 S., R. 1 E.; all secs. 1, 4, 5, 6, 7, 8, 12, 13, 17, 18, 19, 20, 24, 25, 30, 36.

T. 2 S., R. 1 E.; all secs. 1, 12, 13, 24, 25, 34, 35, 36.

T. 3 S., R. 1 E.; all secs. 2, 3, 9, 10, 11, 15, 16, 21, 22, 27, 28, 33, 34.

T. 1 S., R. 2 E.; all secs. 6, 7, 18, 19, 30, 31.

T. 2 S., R. 2 E.; all secs. 6, 7, 18, 19, 30.

T. 1 S., R. 2 W.; all secs. 1, 2, 3, 4, 12, 13, 24, 25.

T. 1 N., R. 1 E., all secs. 25 to 29 inclusive, 32, 33, 34, 35, 36.

T. 1 N., R. 2 E.; all secs. 30 and 31.

T. 1 N., R. 1 W.; all secs. 1, 2, 10, 11, 12, 13, 14, 15, 16, 17, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 32, 33, 34, 35, 36.

T. 2 N., R. 1 W.; all secs. 1, 2, 11, 12, 13, 14, 15, 22, 23, 24, 25, 26, 35, 36.

LUMBERING IN FOREST RESERVES

Millions of Feet of Lumber are Annually Cut with Regard to the Future of the Forests

FEDERAL forest reserves are now fixed facts. It is a serious thing to withdraw from settlement, as the Government has done, some 63,000,000 acres of land. But when the character of this land is understood, and the purposes the reservations will accomplish are known, it will be generally recognized that the area permanently reserved will serve the public best under forest cover. Its topography and soil unfit it for agriculture, but it is admirably suited to tree growth. Wisely administered, it will continuously furnish an immense timber output, while its influence in conserving the water supply for vast dependent agricultural areas will prove of inestimable value.

Without the establishment of reserves, proper control of the public forests is impossible. The present free use of timber is being greatly abused, and there is practically no management of these vast resources and no income from them, unless the timber and land are both sold outright and together. After the establishment of a reserve settlers within its boundaries and those living in its neighborhood are allowed, within definite and reasonable restrictions, free use of timber actually necessary for their domestic needs. The great change for the better, however, is that the reserve laws provide for the sale of timber in small or large quantities to persons both in and outside the reserve. Thus the forests can be made self-supporting, and through funds created in this way they can be protected from fire and be made more productive and useful.

But in making these sales the future of the forest is more considered than the money return from the timber cut. Hence the sales are strictly guarded by bonded contracts between the individuals and the Government. The contracts specify the amount of timber bought and the price to be paid, limit the area and time of cutting, prescribe simple and practical regulations to guard against fire, and cover all essential relations between the contracting parties pending the comple-

tion of the contract. No trees can be cut except those previously marked by a Government official. Under such contracts millions of board feet of lumber are annually being cut from the reserves, to the improvement of their condition.

It is not the Government's purpose to maintain the reserve forests untouched, but to use and develop them. Proper lumbering is as necessary to a productive forest as protection. Mature or ripe trees should be cut not only for the same reason that wheat or corn is, to save and utilize the product, but also to promote reproduction. Agricultural crops require sowing or planting each year, but forests, properly thinned by cutting, reproduce themselves and furnish a continuous crop. That this work may be effectively accomplished there must be protection from fires and proper conditions for tree growth must be maintained. Important among these conditions is the demand of trees for room and sunlight. The young growth must be neither crowded nor shaded out. Thus, for the best results in reproduction the mature trees should be cut, and the dead and diseased timber should be disposed of as rapidly as possible.

Lumbering, however, as heretofore conducted, has had little concern for the effect of its operations on the forest. The immediate purpose was limited to getting out the valuable timber quickly, and little or no attention was given the damage to young growth, necessarily resulting from reckless tree cutting. Reserve management will stop reckless lumbering. The future welfare of the public forests depends on wise regulation of lumbering under such expert control as only the trained forester can exercise. This control must prevent injury to young growth from tree felling, must provide for thinning the forest so as best to assist reproduction, must where necessary resort to tree planting to rebuild the forest, and, most important of all, must prevent or quickly suppress all fires. None of these ends can be successfully attained while the forests remain public lands under no apparent control. Putting them under reserve is reclaiming them from an unguarded and unproductive state. It is the first step in putting them to their best use, through which lumbering and all industries depending on them will most permanently and largely thrive.

UNIQUE STEAM LOG HAULER

Now in Use on Former Chippewa Indian Reservation, Minnesota

BY

EUGENE S. BRUCE

Lumberman, Bureau of Forestry

THE accompanying illustrations will give the interested reader a clear idea of a steam log hauler used by some of the progressive lumbermen of the Northwest for facilitating the long-distance hauling of logs. It is used in localities where the distance which the timber must be transported in order to reach desired streams or railroads is so great as to prohibit its being hauled by teams profitably.

The construction of this steam log hauler involves an adaptation of the general principles of the ordinary

geared locomotive, suitable wheels especially constructed for the purpose, taking the place, on the axle, of the main driving wheels. These wheels are covered with an endless chain or sectional metal belt which is forced to revolve by the revolution of the driving sprocket wheels. The greater portion of the weight of the boiler and locomotive rests on the revolving sections of the metal belt, which are armed with teeth or calks, these being set into the sections transversely. The calks are driven into the ice road by the weight of the machine, thus giving the hauler its traction or friction power for starting and keep the heavily loaded sleds in motion. The front end of the hauling engine rests on the center beam of a movable sled, which is so constructed that it will run forward or backward, and may be turned in any desired direction by the man piloting the hauler, with a lever purchase wheel similar to the guiding wheel on an automobile or an ordinary brake wheel on a car.

The hauler is not confined to forward motion alone, but can be reversed as quickly as any locomotive of this type, and may be guided by the runnered sled into any desired position. That it is a practical success has already been demonstrated. The rate of speed which can be maintained with a load of trailers (coupled log sleds) is from five to seven miles an hour. It is confidently expected that this hauler will be able to handle ten pairs of loaded log sleds on each trip when the roads are in good condition, each pair of sleds carrying 10,000 feet of logs B. M. (log scale).

Steam log hauler in use on the former Chippewa Indian Reservation in Minnesota.

The hauler shown in the illustration was constructed for the Northland Pine Company for use on their own operations, and is at the present time being used by them to haul the logs and timber from three of their lumber camps on the former Chippewa Indian Reservation, in Minnesota, to Pine River, a tributary of the Mississippi. This is an eight-mile trip each way, on which it is expected to make four round trips each day of twenty-four hours.

One of the advantages claimed for this machine is that it does not get tired nor have to stop to rest, a change of the operating crew being all that is necessary to keep "the bull of the woods" moving night and day. Another advantage is that on the return trip to the woods with the empty sleds, when its load is the lighest, the hauler pulls its sprinkling tanks loaded with water for icing the log road, also its rut cutter for clearing out and deepening the rut in which the sleds run, thus practically keeping its track or roadbed in condition for constant use, without any additional help, other than the regular crew working with the hauler. It will be readily understood by the experienced lumberman that this steam hauling device economizes largely in the cost of team hire, which is one of the heaviest expenses of a lumber camp, especially where the haul is long. Besides it gives the operator a chance to use his teams in skidding and in hauling the loaded trailers from the short branch roads out to the main log road, over which the steam hauler passes on its regular trips to and from the landings.

FORESTRY IN CALIFORNIA

A State which Appreciates the Value of its Forests and is Taking Active Measures to Protect Them

CALIFORNIA has over 28,000,000 acres, or over one-fifth of its total area, under forest cover. Much of this land is finely timbered, and, with forest management, will be increasingly valuable for the wood which it can supply. But in California the forests have another use, which, as is well understood in that State, is even more important than the production of timber—to conserve the water supply. The wonderful agricultural development which irrigation has made possible is perhaps the largest fact in California's recent economical history. Because of the need of water and the fear of floods public sentiment in favor of forest protection in California has always been well in advance of that in other States, as was conspicuously illustrated after President Cleveland, in 1897, proclaimed the thirteen Federal Reserves created at the close of his administration. Everywhere else in the West the opposition aroused was so strong that the proclamation was soon afterward temporarily suspended; but a special exception was made in the case of California, where public opinion was from the first strongly in favor of the reserves.

Something less than one-third of the entire wooded area of the State is now embraced in the Federal forest reserves. That the remaining 20,000,000 acres of its forests may be made to serve the public interest in the fullest possible measure, the State has solicited and secured the coöperation of the Bureau of Forestry in working out a proper forest policy for it. Members of the Bureau have, since July, 1903, examined over 21,000,000 acres of forest and brush lands, and by the end of the year the entire State will have been covered.

The different types of land—as timberland, chaparral, pasture and agricultural land, barrens, cut-over land, and burned land—will be mapped and the stand of timber in each location will be roughly estimated. Forest reserves may be increased in number or size, if land most suitable for that purpose is found.

But the subject of paramount importance is the prevention and control of fires. A good opportunity for experiment along this line was afforded the Bureau by coöperation with the private owner of an 80,000-acre tract, who had previously introduced a crude fire-protection system. A comprehensive plan was outlined and its execution begun. There has not been time for a thorough trial, but its installation has had an excellent effect. The patrolling of the tract has been greatly improved, and the neighbors now voluntarily report all fires, whether on or off the tract. There has not been a serious fire on that tract this season. This splendid showing is an impressive object lesson. It proves the efficiency of intelligent care and of fighting fires at the start. The present fire laws of the State are incomplete and inadequate. One result of the work of the Bureau will be the recommendation of a fire law which, if adopted, will be the best ever passed by any State.

The most encouraging fact in forest management is the growing determination of large timberland owners to employ private foresters to handle their holdings. This will ensure a method of lumbering less wasteful than that at present practiced, and, more important by far, it will be the means of better protecting the forests and making them yield a continuous crop. Such expert control will be especially valuable in solving the problem of the best way to get rid of the slash, which, until burned, is a constant menace to the forests. Extensive experiments in slash burning have already been carried on by the Bureau with satisfactory results.

The Bureau agents are also studying the habits and rate of growth of sugar and yellow pine to determine the practicability of lumbering so as to secure a second crop. The field work on these studies is now about complete. A report on what growth and returns may be expected from plantations of different species of gum is nearly ready for transmittal.

The study of chaparral has led to fruitful practical conclusions. It shows in California the same remarkable ability to encroach upon and spread over open country that it exhibits in Texas and elsewhere in the semiarid portions of the southwest. It makes a satisfactory watershed cover, and almost constantly replaces a forest destroyed by fire. Its composition varies with aspect and elevation and with damage by fire.

The natural reproduction of forest trees has been thoroughly investigated by the Bureau, together with the extent of the forest in the past, the effect of fire upon forest reproduction, the contest between chaparral and forest on burned areas, and the rate of growth of young forest trees. Every State which has large valuable forests or a climate which demands extensive irrigation for farming purposes should, in its own interest, adopt a definite and enlightened forest policy. Work similar to that nearing completion in California should be in progress in at least a dozen other States of the Union right now, if vast timber resources are not to be further ruinously depleted and farming interests are to be properly safeguarded.

APPARATUS FOR DISTILLATION OF WOOD

Description of How Turpentine, Wood Alcohol, Wood Oil, and Acetic Acid May be Collected at Low Cost

BY

J. A. MATHIEU

Chemist-Engineer, and Patentee of Retorts

THIS apparatus (No. 769177, Patented Sept. 6, 1904,) is composed of a vertical clay or cast-iron retort built above a fireplace, the flues going all around the retort. The rosin and turpentine escape by outlets and pipes at lower part of retort. An outlet near the top is connected with a condenser, and a cover made of clay is adjusted in top of retort. There is also a cooling cover of general cylindrical shape and of about the size of the retort. It is preferably made of sheet metal. It is open at the bottom, but closed at the top, with the exception of a central aperture, to the upper side of which is fitted a lid. Other parts are a crane for handling the basket, cooling cover, and retort cover, and a shallow water bath made of iron or wood.

Sticks of wood four feet in length or less are transferred from the car into the basket, which has a capacity of one cord. The basket is raised by the crane and brought over the empty retort and lowered. A cover is put on top and the rosin and turpentine run out by the outlet at bottom. The wood vapor is carried by means of the upper pipe to the condenser. The gas which is not condensed is brought back through an iron pipe and burned in the fireplace underneath the retort; this gas gives intense heat.

After sixteen hours the wood is transformed into charcoal; the cover is raised up, and a cooler adjusted on the top of retort. A rod passing through the top of the aperture goes down and catches the knob of basket and raises it up inside the cooler. So far as is necessary it goes over the other retorts and they are carried by an overhead track and lowered down into the shallow bath.

The small aperture is covered and a stream of water is run on top of the cooler and cools down the charcoal in three or four hours. The cooler is taken off; the basket of charcoal is hanged and carried to the charcoal shed and dumped on a platform. Afterwards the basket is taken to the yard to be filled up again with wood. The turpentine and rosin are distillated and purified. The products which are going to the condenser are allowed to settle the liquid part that contains the wood alcohol, which is purified by distillation. The products settled on the bottom are separated by distillation and give turpentine, wood oil, light wood oil, heavy wood oil, and what is left is pitch. All these products are in good demand and can be sold very readily.

The advantages of this patent retort, as compared with the ordinary charcoal kiln, are:

A plant can be put upon one-tenth of the ground needed by charcoal kilns.

Less length of pipe will be needed for this retort.

The retort being placed in a vertical position, the heat is applied more regularly and does not require so much fuel.

A smaller quantity of brick will be needed, and the repairs to brickwork

and retort will be considerably less.

Sixty per cent of the labor needed for a kiln may be saved, for the wood is handled by workmen from wagon or car to the basket, and afterward all work is mechanical as far as putting the charcoal in the car, and in case the charcoal is used in blast furnace, the contents of the basket can be dumped right in the blast furnace.

The gas not condensed is used in the fireplace to heat the retort, and if the wood is dry there will be nearly enough gas to keep the operation going without more solid fuel.

The hot gas, after having heated the retort, is conducted underneath the boiler to make steam.

The hot water coming from the condenser is used to feed the boiler.

This retort I guarantee will make sixty bushels of charcoal per cord of seasoned hard wood.

The charcoal will be free of water, and consequently reduce more ore in a blast furnace, and will be more regular for the use for the manufacture of mining powder.

The amount of wood saved will pay for the plant in less than one year. The vertical position of the retort will allow the turpentine and rosin to run down from the wood without distillation and consequently will be superior and more easily purified.

The vertical position of retort will allow the wood vapor, alcohol, and acetic acid to escape to the condenser without being decomposed; thus the quantity obtained will be greater.

The retort made of the fire clay or cast iron will stand a great deal longer and require less repairs.

This system of retort can be utilized for the distillation of wood, peat, lignite and bones, garbage, and extraction of quick-silver, by making some slight changes.

The working of the system of retort is very simple and does not require the services of a chemist to superintend the work; an intelligent man can do perfectly as well after he receives the necessary instructions.

WOOD AS FUEL

BY

T. S. GOLD

HAVING watched for more than three-quarters of a century the burning qualities of wood in an open fire, I have become somewhat familiar with the peculiarities of many species.

Snapping first attracts our attention. Some woods burn quietly, others always snap—some only occasionally. I do not know what causes snapping. It may be the production of an explosive gas, the result of heat or combustion, or the liberation of an explosive vapor from resinous products in the wood, but neither of these theories explain all cases and conditions.

I will first name some species that I have never known to snap and give some of their burning qualities.

Apple is always a quiet burner and when dry burns freely. It leaves an abundant and beautiful white ash which tradition says was used in cooking in place of pearlash not many generations ago.

Pear, quince, and shad bush burn in a similar manner, but less freely.

Cherry of all varieties, peach and plum make fair fuel, but are inferior to apple. I have never known them to snap, except one tree of black cherry. It is reported that the peach is planted in the vicinity of Buenos

Ayres for use as fuel, as the fastest growing tree.

Burch of all varieties burns quietly. Black birch is the best, and will burn well green. All species of birch should be cut and split while green, that the wood may season properly. Locust burns quietly, but slowly, resisting the fire and melting away with little blaze, as does also the mulberry. White ash and black ash burn quietly, but the former is the best fuel, especially for burning green. The wood choppers of charcoalwood have their own fuel free, persumably from the dead wood, which is not suitable for charcoal, but make free with any nice white ash or hickory standing near their cabins. In the days of the old ovens, white ash was the favorite wood for heating them, as it split readily and burned freely with an abundant blaze.

Elm, willow, and alder are rather soft, spongy woods, that burn quietly, but are not very lasting, nor do they produce very much heat. Hornbeam and blue birch I have never known to snap, and are free burning hard woods. Soft maple never snaps, and when dry makes a very pleasant, still, free-burning wood. The tulip-tree or white-wood, is too valuable for lumber to be consigned to the wood-pile, yet the refuse is easily worked up, and is a free-burner, making a quiet fire.

Spruce, hemlock, fir, cedar, tamarack, and larch always snap; if well seasoned and put in a close stove with a good draft, as soon as the fire is lighted, they give the sound of a pack of exploding fire-crackers, and a sensation of warmth before the cold iron is heated through. All kinds of pine are liable to snap, but the sparks from all these soft woods will die before they scorch the rug, or singe the floor.

Chestnut and butternut are lively snappers, and when dry burn freely, and, being easily worked up, make satisfactory fuel for close stoves. Hickory, the best of all woods for fuel, and keeping fire in buried coals, ordinarily burns quietly, but sometimes it throws live coals viciously across the room. Hard maple, beech, and white oak sometimes throw out hard coals from the heart wood. When well seasoned they are little inferior to hickory in free and enduring burning qualities. The other oaks rarely, if ever snap, but do not burn as freely as the white oak, nor make as firm coals. The common poplar, though a soft and spongy wood, will snap, and when made into charcoal has the reputation of holding fire in the inside of the large pieces, unseen on the outside, and later starting fire in the coal bank or wagon.

Woods to burn green are: White ash, hickory, black birch, hard maple, and white oak. They are more enduring than when dry and kindle almost as readily. To get the best value of wood, it should be cut and split when green and soon housed in a shed or well ventilated wood house, where it will dry without molding. White pine allowed to lie with the bark on the logs, or without splitting, will be devoured by worms during the first summer. They make such a noise in their work that they can be readily heard.

All wood that is left without working up, suffers from worm and incipient decay, mostly in the sap wood. Live wood makes better fuel than when it has died from fire, or other causes. When the butt cut is sound, it will make better charcoal, more weight than the higher cuts, and has relatively the same value as fuel. In old timber, the butt has sometimes lost its life and substance, and is inferior to the rest of the trunk. In most trees, but especially the evergreens, the knots have more fuel value than the straight grained wood.

In the hickory and paper birch, the outer bark has high fuel value, prized for kindlings, otherwise the bark and sap would have less value than the heart. Slab wood as usually treated in the slab pile makes poor fuel, but worked up fresh and dried under cover, the bark still adhering, it makes a lively fire.

Wood grown in the open will give

more heat than the same variety grown in the forest, and up to full maturity wood improves as a heat producer, but later it diminishes as it does in strength and elasticity. The increase of pitch or turpentine in old trees gives them a fuel value far above that of the soft pine or immature growth.

A few observations on heat may appropriately follow: The most vitalizing heat is that of the sun in its direct rays; next is the radiant heat from burning wood or coal. The shepherd and the poultryman know that the direct rays of the sun have a vivifying effect upon the young lamb or chicken, surpassing that derived from any other source, excepting perhaps that from the body of the mother. The heat radiated from a close stove or steam, or hot water pipes may warm the body, but it seems to lack something that is conveyed by the sun's rays.

An open fire is company, with its brisk flame, and lively crackle demanding frequent attention, ungrudging bestowed by any one who accepts its companionship. It whiles away the idle hour between daylight and dark, called "candle-lighting" in the old times, when the blazing hearth bore the backlog and fore stick with high piled lighter wood; with an ample bed of red-hot ashes and coals, fit to receive chestnuts or potatoes, to season them while you wait with the peculiar flavor that those embers alone bestow.

The open fire is always drawing the family together with an unconscious force that no radiator or furnace possesses. It gives a silent lesson in good behavior, though often enforced in words, "Don't go before the fire," "Don't stand before the fire" (that is, before some other person). This is a lesson in unselfishness that is the foundation of all good manners. An old friend standing with me before a blazing fire, recently said, "An open fire is better than a minister in a family any time."

One of the great pleasures of the open fire is in watching the decaying embers as the white ash encircles the buring stick, or the decaying coal, still retaining its size and form to the last. There is a great difference in wood in this respect, and on familiar acquaintance it becomes companionship, so that it is hard to conceive of lonesomeness in the presence of a lively fire, with a store of wood to replenish it.

The weight of opinion is largely in favor of dry wood, and in most varieties this is true, yet there are some hard facts in favor of some kinds of green wood, or conditions of the fire, that cannot be disputed.

Men who run engines for sawing lumber use the green slabs for fuel, and as soon as the fire is well started, do not hesitate to feed in the green slabs covered with snow and ice, claiming that such make the hottest fire.

In the olden times, with their big fire places, green hickory brush was highly prized for fuel; piled high in the old fire place, it made a roaring fire, stronger and more durable than dry brush. So green hickory wood has the preference to-day in many cases. Is there not a highly inflammable volatile oil in the hickory bark while green, which is lost in drying? So with the black birch. What boy would expect to find in the dry birch bark that delicate aroma and flavor which he finds in the green bark? That volatile oil is all gone then, and the farmer says birch burns the best.

Where else do we find the odor of woods and fields, the odor of spring in more sublimated form than when the bursting buds of the birch unite with the fragrance of the wild grape in a perfume unsurpassed by the odors of Araby?

Now the old farmer who has watched on his hearthstone the burning of different kinds of woods, as well as the collier who annually burns his thousands of bushels of charcoal, have some notions about these things that do not exactly harmonize with the claims of the scientist in his laboratory, and it belongs to the latter to

investigate and explain the apparent discrepancies that exist. The old farmer, as he covers up the half burnt brands with the burning embers or reinforces the bed with a stick of hard wood, almost as sure of fire in the morning as he is of sunrise, is an experimenter in a practical way, and his conclusions are worthy of consideration. The housemother, too, sometimes takes up this job, if the husband lacks in force and ingenuity, and becomes a true vestal to keep the fire alive on the family altar. Such a one was the good wife who, when the old curmudgeon tested her temper by bringing all crooked and knotted wood for the kitchen fire; as deftly arranged it about her pots and kettles and the flames wrapped around them, she called his attention to how nicely they fitted their purpose, and pleased her. She was a true philosopher, upon whose hearthstone the fire would never smoke, grow dim, or expire.

USES OF INFERIOR WOODS

The Bureau of Forestry Demonstrates the Value of Woods Now Generally Considered Inferior

WHEN there was an abundant supply of the best quality of timber it was the habit of lumbermen to neglect all but the best species. For instance, in Indiana and Ohio the white oak trees were cut and the red oaks were left. In the South only a few years ago the gum, which is now of considerable commercial importance, was left to rot in the woods. On the Pacific coast the western hemlock was not considered worth transporting from the forest to the mill. In consequence the supply of high class timbers has been seriously depleted, and the character of the forest has been changed by the reproduction of the inferior species which were left in possession; while the lumberman has had to extend his operations over a large area in order to secure the necessary amount of timber. If these inferior species can be cut and marketed at a profit, it will be possible in the future to lumber with far less detriment to the forest, and at the same time the available supply of timber will be greatly increased.

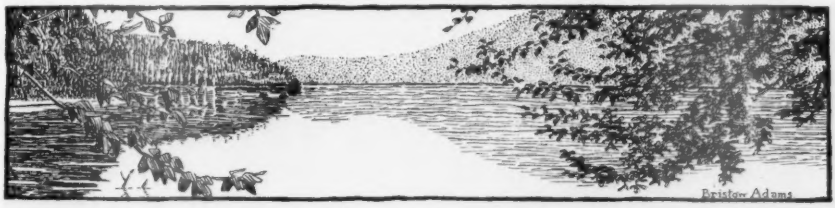
The current unfavorable opinions concerning these so-called inferior species are largely matters of tradition, which investigation proves was unwarranted. Indeed, in some cases, lumber such as gum and sap pine is exported from this country and held in high esteem abroad. Our engineers and architects, as a rule, consider sapwood weaker and much less fit for structural use than heartwood. Of course in the matter of durability of unpreserved timber under severe conditions of exposure, there is no question but that heartwood is very much to be preferred to sapwood. But for use indoors sapwood timbers are abundantly strong. Carriage manufacturers know that the strongest and most resilient wood for spokes, shafts, etc., is rapid grown sapling hickory. It has lately been discovered that fast grown second growth red oak, so far as strength is concerned, is fully equal to white oak. Much work remains to be done to bring out the facts underlying the practicability of a more extensive use of inferior timbers, and to disseminate information as to the relative advantages of first and second growth timbers and the value of such woods as western hemlock and loblolly pine, which are of increasing importance in the national supply of structural timber. The timber tests which the Bureau of Forestry is making are bringing the facts concerning

these matters before the users of timber.

The introduction of western hemlock to the market as a building material has met with many obstacles. The hemlock of the East is far inferior to the Western species as a building wood, and the prejudice existing against the Eastern species is unjustly extended to that of the West. The latter is a hard, straight, and even-grained wood, nearly white in color. It does not split readily, and is light and tough. These characteristics peculiarly fit it for manufacture into boxes. It is also a superior wood for all inside finishing, as it takes a high polish and has excellent wearing qualities. It can be rapidly kiln dried at high temperature without injury. Mechanical tests have shown it to possess about 70 per cent. of the strength of red fir and to be suited for all except the heaviest structural demands. Large quantities of this timber are now sold under other names than its own. There is no just cause for the prejudice which necessitates this deception, and Western hemlock should be handled under its right name.

Another tree which has been discriminated against is the loblolly pine. This is a tree of a wide range of distribution, and Bureau tests have shown that, under proper conditions of growth, it can furnish wood of great structural merit. It, too, is sold under fictitious names, when it should be sold on its merits. The principal objection to it is that it is usually sapwood and decays rapidly when exposed. But it is of open grain and can be very successfully treated with preservatives, which should entirely eliminate this objection. Many of the so-called inferior timbers can be more thoroughly and successfully treated with preservatives than can the more solid timbers. Happily, this is in a marked degree the case with the abundant loblolly pine, and this tree is certain to come into general and appreciated use.

Another phase of this work is in connection with the packing box industry. Very few people appreciate the amount of lumber that goes into the manufacture of packing boxes. Formerly the size of boxes for different purposes, was based on the strength of white pine, which used to be the standard material employed. With the scarcity of white pine and its increased price, gum, cottonwood, loblolly pine, and other woods have come into use for boxes. In many cases these woods are much heavier than white pine, so that there is an added expense for freight because of the extra weight of the boxes. It becomes, then, an important matter to ascertain to what extent the thickness of boxboards commonly used can be reduced without lessening the strength of the box below the necessary requirement. The Bureau of Forestry, in co-operation with the North Carolina Pine Association, is about to take up this problem, and by actual experiment with boxes of different sizes and of various kinds of lumber to determine the extent to which the prevailing thicknesses of boards can be diminished.



TIMBER CUTTING IN MINNESOTA

The Work of Logging the Pine Trees in the Minnesota National Forest Reserve

WHEN completely established the Minnesota National Forest Reserve will contain about 225,000 acres. Of this area 105,000 acres have already been selected by the Government. Under the terms of the Morris law 95 per cent. of the pine timber thereon must be cut. This pine has been sold and the work of cutting was actively prosecuted last year. Nine logging camps were established, and the cutting began early in August. Two camps, which worked under a system of summer railroad logging, shut down for the season in November. The other seven camps, in which winter logging is being done, are still running.

The most interesting of the several operations, from a forester's standpoint, was on sections 15, 16, 17, and 21 of township 145, R. 30. Section 16 was estimated to have the heaviest stand of timber in the former Indian Reservation. The very dense growth made it especially difficult to carry out with the best results the law requiring 5 per cent. of the timber to be left standing for reseeding or reforesting the land. When trees grow so close together that, after felling, the ground is almost completely hidden by their trunks, it is no easy matter to select single trees or small groups of trees so situated that their neighbors can be felled without injuring them. This was, however, successfully done.

The first work undertaken in the four sections mentioned, after locating

Pure Stand of Sapling Norway Pine in the Minnesota National Forest Reserve.

the two summer camps, was opening up and grading the roadbeds for the logging railroads. These roadbeds were cut through the heaviest stands of timber, and it is noteworthy that they required the cutting down of a strip of forest considerably narrower than a wagon road would have involved. From 785 acres of these four sections there were cut between August 8 and November 19 some 16,311,785 board feet of white and Norway pine. From all except 100 acres of this area the brush and debris smaller than 8 inches in diameter were cleared and built into compact piles as the logging progressed. These piles were burned between October 28 and December 23. The brush and debris on the remaining 100 acres were piled and will be burned at a suitable time in the spring. So carefully was the burning done that even in and around section 16 it was completed without injury to the 5 per cent. of seed trees reserved. The area covered by the fires by which the brush and debris were destroyed was only about 7 per cent. of the cut-over land.

The contractors running the seven winter camps are also doing their cutting, hauling, and brush burning under the inspection of the Bureau of Forestry. Each of these camps operated over a larger area this season than did the two camps already mentioned. The timber purchasers have until July, 1908, to finish the cutting and removal of the timber from the sections already sold. Although the regulations for conservative lumbering were new to the lumbermen, they have been applied effectively. Not only have the relations between the Bureau officials in charge of the work and the loggers been entirely friendly, but a radical change in the attitude of the lumber interests of this

Reproduction of Norway Pine on an Old Burnt-Over District in the Minnesota National Forest Reserve.

region towards forestry has taken place, as the result of a better understanding of its methods and its purposes.

An important result of the past season's work was the practical demonstration that it is most effective and most economical to pile and burn brush and debris, so far as practicable, as fast as the logging proceeds. When the burning can not be immediately done, the brush should be kept cleaned up and compactly piled close behind the logging. It can then be burned at a time when there is no danger of the fire spreading or getting beyond control.

In Minnesota, 1904 was a good seed year for both white and Norway pine. Moreover, in many places, in addition to the 5 per cent. of seed trees reserved, there remains after the cutting and brush burning a good stand of young pine too small to be cut, which will now take on more rapid growth. Thus reforestation may be said to have already begun.

The second and final selection of lands to constitute the Minnesota National Forest Reserve will be made as soon as all Indian allotments have been completed, the flowage lines of the War Department's reservoirs in this locality have been definitely fixed, and the question of the status of the lands selected as swamp lands, which inure to the State of Minnesota under the Federal law, has been definitely settled.

RECENT PUBLICATIONS

English Estate Forestry. By A. C. FORBES. Pp. 332. Illustrated. (Edwin Arnold, London.) Longmans, Green & Co., American agents, New York.

This handsome volume is from the pen of a well-known English forester. He describes the beginnings of English forestry, its present condition and its future prospects. There are highly instructive chapters on the most profitable English timber trees and their silvicultural treatment; also on planting and regeneration, thinning and pruning. Landscape forestry naturally comes in for careful discussion, and a suggestive chapter on park timber and avenues adds much value to the volume. A number of excellent photogravures heighten the beauty of a well-printed book. It is a book that, although describing English estate forestry, should be of considerable value to Americans in these days of rising interest in country life and homes.

Musk Ox, Bison, Sheep, and Goat. By CASPAR WHITNEY and others. American Sportsman's Library. Illustrated. Price $2. The Macmillan Company, New York.

This is the latest volume in the excellent series of sporting books being issued under the general title of the American Sportsman's Library, with the able editorship of Mr. Caspar Whitney. Mr. Whitney, along with George Bird Grinnell and Owen Wister, have written the various chapters that go to make up the volume. It records in an accurate and interesting manner the characteristics, range, habits, etc., of these rapidly disappearing animals. These names are sufficient guarantee of the book's accuracy, and should give it a place in the library of all sportsmen.

With the Trees. By MAUD GOING. Pp. 335. Illustrated. Price $1.00. The Baker and Taylor Co., New York.

Miss Going, author of "With the Wild Flowers" and "Field, Forest and Wayside," in her latest book, "With the Trees," has produced a pleasing and instructive untechnical volume for the general reader. With its bright, entertaining style and its many apropos illustrations, it should do much to stimulate a greater love for and interest in our forests.

Mineral Resources of the United States; Calendar Year 1903. By DAVID T. DAY, Chief of Division of Mining and Mineral Resources, U. S. Geological Survey. Pp. 1204. Washington. Government Printing Office, 1904.

Besides mining and mineral statistical matter for the calendar year 1903, there is contained in this volume considerable descriptive and technical matter, obtained while the statistical canvass was in progress. The report should be very valuable to the miner and geologist, and the tabulated matter is of interest to the layman. This is the twentieth annual report published by the Mining Division.

Twenty-first Annual Report of the Agricultural Experiment Station of the University of Wisconsin. For the year ending June 30, 1904. Pp. 392. Illustrated with numerous half tones. Madison, Democrat Printing Co., 1904.

To the annual report of the director of the Agricultural Station is appended nearly a score of articles dealing with various phases of agriculture, and designed to promulgate among Wisconsin farmers generally the principles of practical agriculture as founded on scientific facts. With the development of agriculture that has come during the last quarter of a century, its practice is gradually assuming a semi-scientific character, and the publication of such a volume as this, with its many valuable articles, gives the up-to-date farmer the facts and figures in a convincing manner.

Report on the Condition of Treated Timbers Laid in Texas, February, 1902. Bulletin No. 51, Bureau of Forestry. By HERMAN VON SCHRENK. Pp. 45. Illustrated with 6 half tones. Washington, Government Printing Office, 1904.

This is a report on the present condition of railroad tie timbers, variously treated with certain preservatives which were laid on the Beaumont division of the Gulf, Colorado and Sante Fe Railway, and which have been in use during a period approximating eighteen months. Each tie was numbered and a record kept of the particular preservative process used, duration of same and locality of treating plant, and thirteen kinds of wood were made use of. The report gives general deductions in the form of reading matter, and specifies in tabulated form the result to each particular tie laid.

Report Upon the Administration of the Public Works Department in Egypt for 1903. By SIR WILLIAM GARSTIN, G. C. M. G. Pp. 430. Illustrated with numerous maps and diagrams. Cairo; National Printing Department, 1904.

Of most interest to American readers are those portions of this volume which are devoted to irrigation, although the entire publication has many interesting reports and articles which would attract the general reader. The figures given illustrating the increase in value of land in Middle Egypt, ascribed to the influence of the Asyut Barrage, the Aswan Dam and other irrigation works along the Nile, are convincingly eloquent of the splendid services rendered Egypt by the Public Works Ministry.

Federal and State Forest Laws. Bulletin No. 57, Bureau of Forestry. Compiled by GEORGE W. WOODRUFF, A.B., LL.B. Pp. 259. Washington, Government Printing Office, 1904.

As the title indicates, this volume is a compilation of the various Federal and State statutes bearing on forestry, and Mr. Woodruff has arranged them by States, in alphabetical order, under the heads of Constitutional Provisions; Administration and Use; Trespass on Private Lands and Trespass on Public Lands; Forest Fires in General and Those Caused by Railroads; Bounties, Rebates and Exemptions; Investigation, Education and Public Observance. There is also included an appendix, with a table with information concerning present forest reserves, timber reservations, national parks, etc. The Bulletin is especially intended to help the Federal and State officials who deal with forest questions, as well as the layman who wishes information concerning forest legislation. It is one of the most helpful publications that the Bureau of Forestry has yet issued.

Methods Used for Controlling and Reclaiming Sand-dunes. Bulletin No. 57. Bureau of Plant Industry. By A. S. HITCHCOCK. Pp. 36. Illustrated with 9 half-tone plates and 9 text figures. Washington, Government Printing Office, 1904.

On the Atlantic and Pacific coasts, on the shores of the Great Lakes, and at numerous places inland, there are areas of sandy land, for the most part originally covered by vegetation, but now denuded of plant-growth through the too-prevalent American idea of utilizing everything in sight, without thought for the future. Sand-dunes have in many places proved a positive menace, and Mr. Hitchcock gives an outline of the methods followed in the Netherlands, Denmark, Germany and France.

Cost of Pumping for Irrigation. Bulletin No. 49, University of Arizona Experiment Station. By SHERMAN M. WOODWARD. Pp. 12. Tucson, November 28, 1904.

A very interesting little pamphlet, which describes in a simple manner the construction of home irrigation systems, and details cost of the same.

Irrigation in the United States: 1902. Bulletin No. 16, Bureau of the Census. Pp. 92. Washington, Government Printing Office, 1904.

This volume contains very valuable statistical matter regarding irrigation in this country, which is amplified upon and made more interesting by historical and descriptive reading matter on the subject.

How Plant Life is Distributed in Canada and Why. By A. T. DRUMMOND. Reprint. Pp. 16.

In this little phamphlet Mr. Dummond discusses in an interesting and popular way the causes which influence distribution of plant growth in Canada and summarizes briefly the general aspects of vegetation in the various groups readily distinguishable, noted as the Canadian, Forest, Maritime, Eastern Coast, Erie, St. Lawrence, Boreal, Ontario, Prairie, Western Plains, Rocky Mountain, British Columbia, Southern British Columbia, Cascade, Arctic, and European. In estimating the age of Canadian flora, Mr. Dummond says there are certain species which have existed since the early Eoncee Era.

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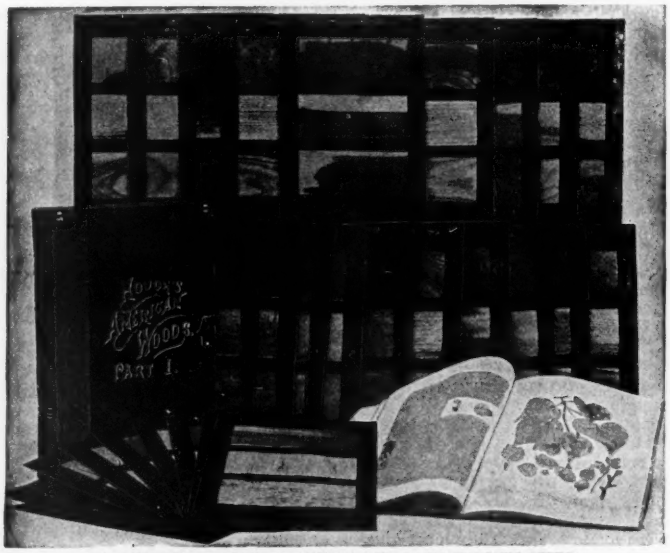

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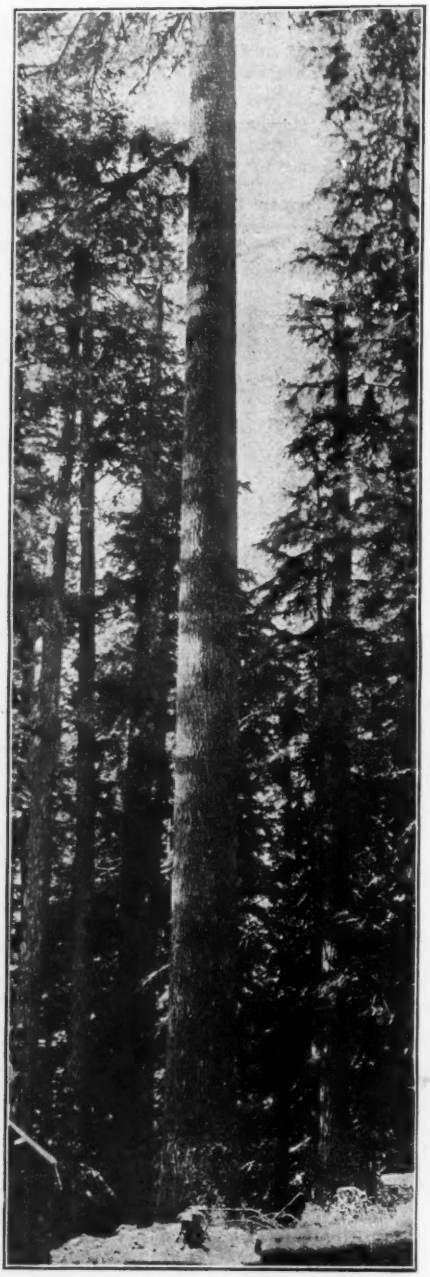

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The objects of the Association, as set forth in its Constitution, are as follows:

1. The adoption by the Federal Government of a permanent policy for the reclamation and settlement of the public domain, under which all the remaining public lands shall be held and administered as a trust for the benefit of the whole people of the United States, and no grants of the title to any of the public lands shall ever hereafter be made to any but actual settlers and homebuilders on the land.

2. The preservation and development of our national resources by the construction of storage reservoirs by the Federal Government for flood protection, and to save for use in aid of navigation and irrigation the flood waters which now run to waste and cause overflow and destruction.

3. The construction by the Federal Government of storage reservoirs and irrigation works wherever necessary to furnish water for the reclamation and settlement of the arid public lands.

4. The preservation of the forests and reforestation of denuded forest areas as sources of water supply, the conservation of existing supplies by approved methods of irrigation and distribution, and the increase of the water resources of the arid region by the investigation and development of underground supplies.

5. The adoption of a harmonious system of irrigation laws in all the arid and semi-arid states and territories under which the right to the use of water for irrigation shall vest in the user and become appurtenant to the land irrigated, and beneficial use be the basis and the measure and limit of the right.

6. The holding of an annual Irrigation Congress, and the dissemination by public meetings and through the press of information regarding irrigation, and the reclamation and settlement of the arid public domain, and the possibilities of better agriculture through irrigation and intensive farming, and the need for agricultural education and training, and the creation of rural homes as national safeguards, and the encouragement of rural settlement as a remedy for the social and political evils threatened by the congestion of population in large cities.

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